EPIDURAL ANESTHESIA IN CHILDREN

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Анестезиология и Реаниматология(Ординатор 2-го года)

Paediatric central neuraxial blockade is a well-recognised and valuable technique for achieving perioperative and post-operative pain control. Lumbar and thoracic epidural insertion remain important modalities for pain control and when working effectively, are considered the gold standard for post-operative analgesia in children (1). Evidence suggests that pain control is at least comparable and in many cases improved when compared with intravenous techniques (2). Epidurals provide optimal analgesia whilst avoiding opioid-related side effects, with studies demonstrating fewer episodes of hypoxaemia or respiratory depression and a reduced need for postoperative ventilation and intensive care (3). There is also greater haemodynamic stability, improved gastrointestinal function, less nausea and vomiting and a reduced neurohumeral stress response (4). It is worth remembering however that epidural opiates can also result in systemic complications.

The use of paediatric epidural anaesthesia is falling in the UK, with numbers between 2006 and 2011 having fallen by 40% (2). This can be attributed to an increase in laparoscopic surgery, as well as the development and success of other regional or local anaesthetic techniques (2). However epidural and other neuraxial techniques still remain in common practice, primarily employed as an adjunct to general anaesthesia. The anatomy of the epidural space varies when comparing neonates and children to adults. The physiology and pharmacologic effects of drugs on this age group are similarly variable and these all need to be taken into consideration when performing paediatric epidural anaesthesia. Indications, contraindications and complications should be discussed and the decision for epidural insertion always made on an individual basis after a careful risk/benefit analysis. There continues to be debate regarding safe insertion practices (awake versus asleep), as well as recent developments in technique and performance with the introduction of ultrasound.

The majority of neuraxial blocks in children are used in combination with general anaesthesia or sedation, with relatively few situations prompting their use as a sole anaesthetic technique. There may be patients in whom it is preferable to avoid general anaesthesia, for example a hypotonic infant, a child with a history of apnoeas, bronchopulmonary dysplasia or other conditions that may require prolonged ventilation, patients with cystic fibrosis, those with a history of malignant hyperthermia, or occasionally older children who prefer to remain awake (5).

Decisions regarding epidural use should be made on an individual basis and should also consider the potential for additional benefits in children with comorbidities. For example children with Cerebral Palsy undergoing painful lower limb procedures would benefit from epidural use, particularly as pain assessment may be difficult in those with intellectual disabilities or poor communication (6).

In patients with asthma or respiratory disease a functioning epidural will serve to block afferent pain pathways and thereby aid maintenance of respiratory muscle function and adequate ventilation. Lumbar or thoracic epidurals are effective in providing analgesia for thoracic, abdominal and orthopaedic procedures. There has been proven benefit of epidural analgesia for general surgery, major urological procedures, orthopaedics, spinal and plastic surgery. Compared with intravenous techniques, epidural analgesia, either continuous or patient controlled is associated with lower pain scores and a reduced incidence of post-operative nausea and vomiting (2)

Similar to adults, there are a number of absolute and relative contraindications to paediatric epidural insertion. A lack of parental consent or a lack of patient assent (in the older child > 12 years) should preclude insertion in these patients. Other absolute contraindications would include local infection at the site of insertion, coagulopathy or true local anaesthetic allergy. Relative contraindications may include anatomic abnormalities, neurological disease, sepsis, immunodeficiency, raised intracranial pressure, previous spinal surgery or the requirement for post-operative testing of motor or sensory function.

The anatomy of the epidural space and physiological responses vary with age. This has important implications when considering epidural anaesthesia in paediatric patients. The response to and handling of drugs by the body also varies, particularly in term and pre-term neonates. The spinal cord terminates at L3 in term neonates, compared with L1 in adults, a difference that remains apparent up to approximately 12 months of age (3). Similarly the dural sac in neonates terminates at S3, but at S1-S2 in adults. An imaginary line drawn between the two superior iliac crests (intercristal line) should be below the level of the spinal cord at any age (3). This line is typically at the L3-4 interspace or the fourth lumbar vertebra in adults but tends to pass closer to the 5th lumbar vertebra in children and the L5-S1 interspace in neonates (3). Additional anatomical differences in paediatric patients include incomplete ossification of the vertebral bones, a thin ligamentum flavum and a larger, more compliant epidural space with less fat and fibrous tissue. This allows greater ease for insertion of epidural catheters to higher levels from lower approaches (3). Epidural blockade in children produces significantly less haemodynamic disturbance than is seen in adults (3). Hypotension is rarely seen in children under 8 years of age, a product of a lower circulating volume in the lower limbs and splanchnic system, and a relative lack of

resting peripheral vascular tone (3). In older patients, the block to sympathetic tone results in a small but consistent reduction in blood pressure, by up to 20-25%.

Principles of safe paediatric epidural insertion apply as they would for neuraxial anaesthesia in all patients and this tutorial will therefore not describe in detail the standard epidural technique. However, it is essential that the procedure includes application of appropriate patient monitoring, skin preparation, maintenance of sterile conditions and use of a test dose to reduce complications. During placement of the epidural needle, the child is typically placed in the lateral decubitus position with hips and knees flexed and spine arched to open the interlaminar space (1). A midline approach is typically used and a loss of resistance technique applied as in adult patients. The thoracic vertebral spines remain almost horizontal until adolescence, thus a midline approach to the thoracic epidural space can be used (3). A large prospective study (5) by the French-Language Society of Paediatric Anaesthetists (ADARPEF) concluded amongst its findings that it is safer to use loss of resistance to saline rather than to air in neonates and infants.

The determination of total volume for injection depends on the location of the surgery and the level of the epidural catheter. In younger children, the recommended dose is 0.04mL/kg/segment as an initial bolus. In children older than 10 years, a useful calculation is: Volume (in mL) per spinal segment to be blocked = 1/10 x age in years (1). Perhaps an easier way of calculating this would be to consider the surgery itself and load with 0.25-0.5mL/kg of 0.25% bupivacaine for lumbar epidurals and approximately half that for thoracic. Keeping in mind maximum dose recommendations, this dose of 0.25% can either be repeated with half the initial volume after 1-2 hours or a continuous low-dose infusion commenced, e.g. 0.2-0.4mL/kg/hour of 0.1% bupivacaine (5). Drug accumulation may occur in infants under 12 months of age, so infusion rates should be reduced (1).

Epidural insertion continues to have a role in major paediatric surgery, particularly for perioperative and post-operative pain management. Studies have demonstrated significant benefits and reduced morbidity with epidural use and complication rates remain low. It is important to understand the variations in anatomy and pharmacology in the neonatal and paediatric population and adjust technique and dosing accordingly. With increased availability and use of ultrasound, the safety of epidural insertion under anaesthesia may be further improved. Adequate post-operative management should be in place in order to improve the safety and efficacy of paediatric epidurals and to minimise potential complications. When there are issues post-operatively, although they may be related to the epidural, it is important to consider other more likely causes.

REFERENCE

1. Marhofer P, Ivani G, Suresh S, Melman E, Zaragoza G, Bosenberg A. Everyday regional anesthesia in children. Pediatric Anesthesia 2012; 22: 995-1001.

2. Moriarty A. Pediatric epidural analgesia (PEA). Pediatric Anesthesia 2012; 22: 51-55.

3. Patel D. Epidural analgesia for children. Continuing Education in Anaesthesia, Critical Care and Pain 2006; 6(2): 63-66.

4. Marhofer P, Keplinger M, Klug W, Metzelder M. Awake caudals and epidurals should be used more frequently in neonates and infants. Pediatric Anesthesia 2015; 25(1): 93-99.

5. Oechsner H, Ehlers M. Central Neuraxial Blocks in Paediatrics. Department of Anaesthesiology, Albany Medical Centre. AMC Anaesthesiology.

6. Darcey M. Anaesthetic management of patients with Cerebral Palsy. AAGBI Anaesthesia Tutorial of the Week 2010; 196. https://www.aagbi.org/sites/default/files/196-Anaesthetic-management-of-patients-with-CerebralPalsy.pdf