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Epidural Analgesia for Pediatric in Cardiac Surgery

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Introduction

Adding regional anesthesia to general anesthesia for children undergoing cardiac surgery is receiving increasing attention from clinicians. Several studies have demonstrated benefits of regional anesthesia in adult and pediatric patients undergoing major surgery.

In infants and small children, Ultrasound US guidance provides ample anatomical formation to perform neuraxial blockers. We can measure the distance from the skin to the epidural space in the US image and can refer to it during needle insertion. The goals of postoperative analgesia in children are pain eradication, prevention of progression of acute postsurgical pain or hyperalgesia. Acute postoperative pain should be treated to progress to chronic pain in 20% of children [1,2].

Traditionally, opioids have been used for postoperative pain relief in children [3]. Currently, multimodal analgesia is increasingly preferred, where non-opioid analgesia is combined with a small dose of opioids [3,4].

Epidural blockers are commonly used for pediatric analgesia, analgesia after abdominal, pelvic and thoracic surgery. Epidural in children due to the smaller body size, requires considerable experience and a high level of skill. The distance to the epidural space is short in infants and children, and changes in body habits with increasing age are variable, making the distance from the skin to the epidural space is difficult [5].

The veritable column and the spinal cord of infants and children show significant differences compared to adolescents and adults. At birth, the conus medullaris and dural sac end are located at the L4 - L5 or L5 - S1 level in children [5].

The fascia and sheaths within the epidural space are loosely attached to the nerve trunk and muscles, and up to 6-8 years of age, the epidural fat is very fluid in children. This enable easy spread of local anaesthetic especially their distal spread. The drugs leaks into the para vertabral space where spinal nerve roots reside, a relatively large volume of local anaesthetic is required to obtain the same blocker level with epidural analgesia in adults [6].

In small children, the L4-L5 interspace is mostly commonly selected for epidural catheterization. From one year of age onwards, the frequency of the catheter reaching the expected level decreases and coiling of the catheter is not uncommon [7,8].

This is related to the development of the lumbosacral curvature due to habits after age, related to standing and walking. So, epidural puncture levels for catheterization when surgical site is heart (visceral /segment T1 - T5), puncture level is T5 -T6 [9,10].

There is a study demonstrated that the epidural catheter in pediatric patients can be placed through the caudal, lumbar, or thoracic approach. The catheter tip should be placed near the surgery, level in order to provide on effective analgesia. There is a higher risk of neural damage in the thoracic approach.

During the lumber approach, advancing the epidural catheter from the lumber interspace to the target thoracic level often resulted in incorrect positioning of the catheter [10].

Blanco et at. [11] reported that the catheter reached the expected level in only 22% of 39 children old than 1 year when it was advanced from the lower lumber level with a perpendicular midline approach. Epidural analgesia is useful during pediatric surgery and for postoperative anesthesia. In upper abdominal or chest surgery.

Thoracic epidural anesthesia through a catheter in serted by the caudal approach has been tested by several authors with differing results. In third of phase of a study by Bösenberg et al. in which an 18-G catheter was used. The thoracic level was reached in all the neonates enrolled. Gunter and Eng Solved the lumbosarcal curvature that appears after age 1 year as a consequence of standing and walking by threading a styetted 24-G catheter into the caudal space [12-14].

Epidural Analgesia

Thoracic epidural anesthesia [TEA] for sternotomy analgesia involves injection of local anaesthetic into the epidural space to block the first five thoracic segments of the spinal cord. Owing to its blockade of cardic sympathetic innervation arising from the T1 _ T2 segments, TEA has gained interest as an adjuvant to general anesthesia in Cardiac patients. Although the sympathectomy may decrease peripheral vascular resistance, studies demonstrate that TEA during cardiac surgery reduces risk of perioperative myocardial infarction, respiratory depression and atrial arrhythmias. Use of TEA incardic surgery remains controversial because of theoretical risk of epidural hematoma, but this risk has not been substantiated.

Epidural morphine

Epidural morphine was demonstrated to be safe and beneficial by Rosen and Rosen (14), who performed a randomized controlled trial of 32 patients, half of whom received a single shot of epidural morphine immediately following the surgical procedure. There were no events of respiratory depression noted among the 16 patients in their study group, and both postoperative morphine use and pain scores were significantly decreased.

The use of epidural analgesics has primarily been described as a ‘single shot’ dose administered in the operating room. Peterson et al. [15] reviewed the records of 220 pediatric cardiac operations with anesthetic management that included regional anesthesia, administered as a ‘single shot’ anesthetic or as an infusion via an epidural catheter. The authors noted that 89% of their patients were able to be extubated in the operating room. Of these, eight patients were re-intubated within 24 h. Similarly, Leyvi et al. [16] found that a single-shot epidural dose of morphine and bupivacaine was beneficial, decreasing the amount of time required for mechanical ventilation and increasing the success of extubation of patients in the operating room.

In a study of children undergoing open heart surgery, epidural morphine administration attenuated the adverse decrease in T3 (liothyronine) concentration associated with cardiopulmonary bypass [17].

Ultrasound Guidance

Ultrasoundgraphy is practical option for epidural catheter placement in children weight between 0.95 and 23.3 kg. The advantages include direct visualization of all neuraxial structures by ultrasonography and fewer bone contacts during epidural catheter placement compared with a technique that relies purely on the loss Of Resistance (LOR) technique; the most popular method for detecting the epidural space [18,19].

In choosing to use an epidural block in neonates and small infants the risks and benefits should be taken into consideration; in experienced hands the risk is low.

The measuring points for skin-epidural distance and diameter of epidural space are illustrated in figure1.

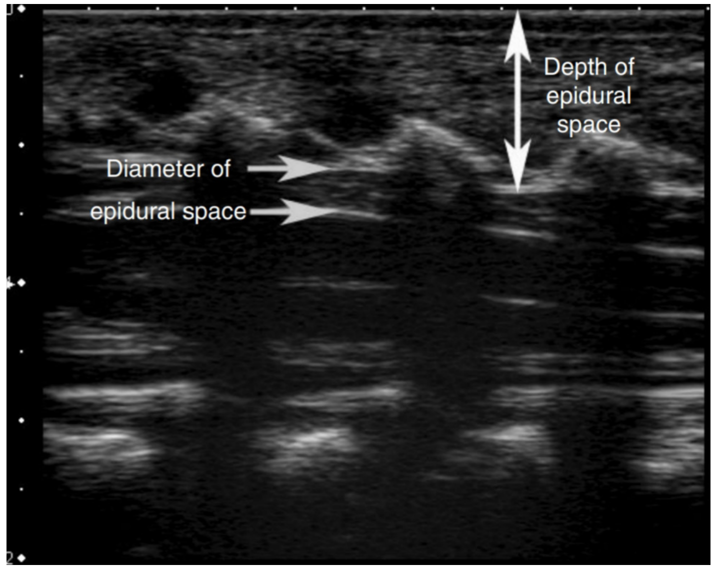

Figure 1: Measuring points for skin epidural distance and diameter of epidural space in a longitudinal transversal ultrasonographic view. The lower grey arrow indicates the dura.

The skin–epidural distance depth varies in the growing child. A number of formulae have been developed for estimating the skin–epidural distance [20,21] but these are inaccurate in children under 6 months [21]. The depth of epidural space can be established using ultrasonography as 70–100% of the dura mater is visible in newborns and infants up to 3 months of age. Although this visibility is increasingly reduced in older children it is still possible to calculate the distance from the skin to the dura. In this study good correlation between the distance determined clinically and that measured by ultrasound was demonstrated, particularly in children less than 6 months of age.

Postoperative Epidural opiates in children

The use of epidural narcotics for postoperative analgesia in children is becoming more common. The wide effects encountered are similar to those noted with adults. Radiological assessment of contrast injected through epidural catheters in babies (1.8–4.5 kg) after major surgery found that both the quality and extent of spread were different for every baby. Filling defects and ‘skipped’ segments were common. Spread was more extensive after 1 ml kg1 compared with 0.5 ml kg1 (mean 11.5 [3.03] vs 9.3 [3.68] segments, P=0.014) (but not twice as great) with fewer ‘skipped’ segments and greater density of dye. Notably, pruritus, nausea, urinary retention and respiratory depression are seen, these side effects are dose related, can be treated when necessary with diphenhydramine, antiemetics and small doses of naloxone while maintaining good levels of analgesia.

The dosage recommendations I use are 30_75 {usually 50} Mg/kg epidural morphine as single dose. Epidural Fentanyl can be safely administered in a dose of 1_1.5 Mg/Kg as a bolus [22,23].

Discussion

We reviewed our experience on the use of epidural analgesia in perioperative pediatric cardio surgery is still controversial. Much of the argument against using spinal or epidural

Flandin-Blety and Barrier [24] reviewed more than 24 000 noncardiac pediatric patients who had received an epidural anesthetic/analgesic; they reported only five complications related to the technique, none of which were epidural hematoma formation. There are no reports of spinal hematoma related to neuraxial anesthesia in patients undergoing CPB or any closed claims on file in the registry. However, with fewer than 1500 reports on the safe use of epidural anesthesia in children undergoing systemic heparinization for CPB, only 30% of which were thoracic, the total sample size lacks the statistical power needed to make a definitive statement regarding the safety of this technique.

Peterson et al. [25] reported that the calculated maximal risk for spinal cord injury related to epidural analgesia was 2% of 220 patients, using the 3/n rule [26] to estimate the upper limit of the 95% CI for proportions with 0 in the numerator. Based on the 750 patients in our study, the maximal risk could be estimated at 0.04%, a level that might be comfortable for most anesthesiologists.

Early extubation in the postoperative congenital heart surgery patient has been a goal since the early 1980s [27,28]. The highest success rate for early extubation, 97% (87.1% at the completion of the procedure and 93.6% within 4 h), was reported by Vricella et al. [13]. Their study included 201 patients who were able to undergo a same-day admission, ultra-fast track, elective cardiac surgery. Five of 188 patients (2.7%) failed early (<4 h) extubation. The practice of early extubation, whether it be in the operating room or intensive care unit, has become more prevalent.

Failed extubation in children following cardiac surgery has been reported to range from 2.6% to 25% [29-31]. Extubation failure has been attributed to upper airway obstruction and cardiorespiratory failure.

The use of epidural anathesia in adult and children to attenuate the stress response and decrease mortality and morbidity associated with cardiac surgery is supported by several studies. Patient receiving thoracic epidural anathesia for cardic surgery have reduced serum catecholamine and stress hormone concentration [32-39].

Epidural anathesia with bupivacaine suppresses the increase in serum catecholamine, glucose, and adrenocorticotropine hormone more effectively than IV fentanyl in infants.

In addition to the reduction in surgery stress response, the use of these regional anathesia technologies during and after cardic surgery may result in improved pulmonary function, greater circulatory stability, and better postoperative pain control compared with general anesthesia alone and postoperative IV opioid analgesia [40].

References

1. Katz J, Seltzer Z. Transition from acute to chronic postsurgical pain: risk factors and protective factors. Expert Rev Neurother. 2009; 9: 723-744.
2. Rabbitts JA, Fisher E, Rosenbloom BN, et al. Prevalence and predictors of chronic postsurgical pain in children: a systematic review and meta-analysis. J Pain. 2017; 18: 605-614.
3. Ferland CE, Vega E, Ingelmo PM. Acute pain management in children: challenges and recent improvements. Curr Opin Anaesthesiol. 2018; 31: 327-332.
4. American Society of Anesthesiologists Task Force on Acute Pain Management. Practice guidelines for acute pain management in the perioperative setting: an updated report by the American Society of Anesthesiologists Task Force on Acute Pain Management. Anesthesiology. 2012; 116: 248-273.
5. Tsui BC. Ultrasound imaging for regional anesthesia in infants, children, and adolescents: a review of current literature and its application in the practice of neuraxial blocks. Anesthesiology. 2010; 112: 719-728.
6. Dalens BJ, Truchon R. Neural blockade for pediatric surgery. In: Cousins MJ, Carr DB, Horlocker TT, Bridenbaugh PO, editors. Cousins & Bridenbaugh's Neural Blockade in Clinical Anesthesia and Pain Medicine. 4th ed. Philadelphia: Lippincott Williams & Wilkins, a Wolters Kluwer business; 2009. pp. 596–611.
7. Kim YA, Kim JY, Kil HK, et al. Accuracy of the epidural catheter position during the lumbar approach in infants and children: a comparison among L2-3, L3-4, and L4-5 approaches. Korean J Anesthesiol. 2010; 58: 458-463.
8. Blanco D, Llamazares J, Rincón R, et al. Thoracic epidural anesthesia via the lumbar approach in infants and children. Anesthesiology. 1996; 84: 1312-1316.
9. Sethna NF, Clendenin D, Athiraman U, et al. Incidence of epidural catheter-associated infections after continuous epidural analgesia in children. Anesthesiology. 2010; 113: 224-232.
10. Kinirons B, Mimoz O, Lafendi L, et al. Chlorhexidine versus povidone iodine in preventing colonization of continuous epidural catheters in children: A 26. randomized, controlled trial. Anesthesiology. 2001; 94: 239-244.
11. Bosenberg AT, Bland BAR, Schulte-Steinberg O, et al. Thoracic epidural anesthesia via caudal route in infants. ANESTHESIOLOGY. 1988; 69: 265-269.
12. Blanco D, Llamazares J, Martinez-Mora J, et al. Anesthesia epidural toracica por via caudal en anestesia pediatrica: La edad es un factor limitante. Rev Esp Anestesiol Reanim. 1994; 41: 214-216.
13. Gunter JB, Eng C. Thoracic epidural anesthesia via the caudal

approach in children. ANESTHESIOLOGY. 1992; 76: 935-938.

14. Rosen KR, Rosen DA. Caudal epidural morphine for control of pain following open heart surgery in children. Anesthesiology. 1989; 70: 418-421.
15. Peterson KL, DeCampli WM, Pike NA, et al. A report of two hundred twenty cases of regional anesthesia in pediatric cardiac surgery. Anesth Analg. 2000; 90: 1014-1019.
16. Leyvi G, Taylor DG, Reith E, et al. Caudal anesthesia in pediatric cardiac surgery: does it affect outcome? J Thorac Cardiovasc Surg. 2005; 19: 734-738.
17. Anand KJS, Hansen DD, Hickey PR. Hormonal-metabolic stress responses in neonates undergoing cardiac surgery. Anesthesiology. 1990; 73: 661-670.
18. Flandin-Blety C, Barrier G. Accidents following extradural analgesia in children. The results of a retrospective study. Paediatr Anaesth. 1995; 5: 41-46.
19. Rose JB. Spinal cord injury in a child after single-shot epidural anaesthesia. Anaesth Analg. 2003; 96: 3-6.
20. Hasan MA, Howard RF, Lloyd-Thomas AR. Depth of epidural space in children. Anaesthesia. 1994; 49: 1085-1087.
21. Bosenberg AT, Gouws E. Skin-epidural distance in children. Anaesthesia. 1995; 50: 895-897.
22. Attia J, Ecoffey C, Sandouk P, et al. Epidural morphine in children: pharmacokinetics and CO2 sensitivity. Anesth. 1986; 65: 590-594.
23. Willer JC, Bergeret S, De Broucker T, et al. Low dose epidural morphine does not affect non-nociceptive spinal reflexes in patients with postoperative pain. Pain. 1988; 32: 9-14.
24. Flandin-Blety C, Barrier G. Accidents following extradural analgesia in children: the results of a retrospective study. Paediatr Anaesth. 1995; 5: 41-46.
25. Peterson KL, DeCampli WM, Pike NA, et al. A report of two hundred twenty cases of regional anesthesia in pediatric cardiac surgery. Anesth Analg. 2000; 90: 1014-1019.
26. Giaufre E, Dalens B, Gombett A. Epidemiology and morbidity of regional anesthesia in children: a one-year prospective survey of the French language society of pediatric anesthesiologists. Anesth Analg. 1996; 83: 904-912.
27. Barash PG, Lescovich F, Katz JD, et al. Early extubation following pediatric cardiothoracic operation: a viable alternative.Ann Thorac Surg. 1980; 29: 228-233.
28. Heard GG, Lamberti JJ, Park SM, et al. Early extubation after surgical repair of congenital heart disease. Crit Care Med. 1985; 13: 830-832.
29. Davis S, Worley S, Mee R, et al. Factors associated with early extubation after cardiac surgery in young children. Pediatr Crit Care Med. 2004; 5: 63-68.
30. Harrison AM, Cox AC, Davis S, et al. Failed extubation after cardiac surgery in young children: prevalence, pathogenesis and risk factors. Pediatr Crit Care Med. 2002; 3: 148-152.
31. Giaufre E, Dalens B, Gombett A. Epidemiology and morbidity of regional anesthesia in children: a one-year prospective survey of the French language society of pediatric anesthesilogists. Anesth Analg. 1996; 83: 904-912.
32. Stenseth R, Bjella L, Berg EM, et al. Thoracic epidural analgesia in aortocoronary bypass surgery. II. Effects on the endocrine metabolic response. Acta Anaesthesiol Scand. 1994; 38: 834-839.
33. Moore CM, Cross MH, Desborough JP, et al. Hormonal effects of thoracic extradural analgesia for cardiac surgery. Br J Anaesth. 1995; 75: 387-393.
34. Fawcett WJ, Edwards RE, Quinn AC, et al. Thoracic epidural analgesia started after cardiopulmonary bypass: adrenergic, cardiovascular and respiratory sequelae. Anaesthesia. 1997; 52: 294-299.
35. Liu S, Carpenter RL, Neal JM. Epidural anesthesia and analgesia: their role in postoperative outcome. Anesthesiology. 1995; 82: 1474-1506.
36. Rosen KR, Rosen DA. Caudal epidural morphine for control of pain following open heart surgery in children. Anesthesiology. 1989; 70: 418-421.
37. Anand KJS, Hansen DD, Hickey PR. Hormonal-metabolic stress responses in neonates undergoing cardiac surgery. Anesthesiology. 1990; 73: 661-670.
38. Fenton KN, Heinemann MK, Hickey PR, et al. Inhibition of the fetal stress response improves cardiac output and gas exchange after fetal cardiac bypass. J Thorac Cardiovasc Surg. 1994; 107: 1416-1422.
39. Rosen DA, Rosen KR, Matheny JM, et al. Maintenance of T3 levels in children undergoing cardiac surgery [abstract]. Anesthesiology. 1997; 87: A1069.
40. Gregory B. Hammer, Khanh Ngo§, and Alex Macario,et al. A Retrospective Examination of Regional Plus General Anesthesia in Children Undergoing Open Heart Surgery. Anesth Analg. 2000; 90: 1020-1024.

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