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Bladder exstrophy-epispadius complex. An overview of anaesthetic management

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Keypoints

We evaluated use of continuous caudal epidural infusion of bupivacaine and fentanyl with general anesthesia for urinary bladder exstrophy-epispadius surgery in children. Fifteen patients, 1month - 9 years age, weighing 3 - 30 kg, ASA grade II to IV, for epispadias-exstrophy complex were treated. Initial bolus 0.75 ml/kg of 0.125% bupivacaine with fentanyl 1µg/kg with maximum volume of 12 ml was administered. Patients remained hemodynamically stable except occasional bradycardia. Postoperative analgesia was maintained by continuous infusion of 0.0625% bupivacaine @ 0.1ml/kg/hr. in young children and 0.125% bupivacaine with fentanyl 1µg/kg in older children for 4-5days. Postoperatively FLACC scale was between 0.5 - 2.4 and mean sedation score less than two. Perioperative anesthetic and analgesic management of the bladder exstrophy patient can improve the success rate. Epidural bupivacaine with or without fentanyl infusions for short duration can provide safe analgesia without any complications.

Abstract

Introduction

The anaesthetic management of urinary bladder exstrophy-epispadius complex is challenging. This paper describes our experience of fifteen children operated in a workshop.

Purpose

We evaluated use of continuous caudal epidural infusion of bupivacaine and fentanyl with general anesthesia for urinary bladder exstrophy-epispadius surgery in children.

Methods

Fifteen patients, 1month - 9 years age, weighing 3 - 30 kg, ASA grade II to IV, for epispadias-exstrophy complex were treated. Anaesthetic management include a combined epidural and general anesthetic technique. Epidurally initial bolus 0.75 ml/kg of 0.125% bupivacaine with fentanyl 1µg/kg was given. Postoperative analgesia was maintained by continuous infusion of 0.0625% bupivacaine @ 0.1ml/kg/hr. in young children and 0.125% bupivacaine with fentanyl 1µg/kg in older children for 4-5days. Postoperative pain was assessed using face, legs, activity, cry and consolability (FLACC) pain scale and sedation score was assessed by using four point sedation score.

Results

Sacro-coccygeal anomaly was found in three patients. Epidural catheter was introduced through lumber space (n=3) and caudal space (n=12). The caudal epidural space was identified on first or second attempt. Patients remained hemodynamically stable except occasional bradycardia. Duration of surgery was 5-7hours. Two patients for mechanical ventilation and two patients for observation were shifted to neonatal ICU. Se-

dation score was below two and FLACC pain scale was below four.

Conclusions

Perioperative management with general anesthesia and epidural catheters for analgesia in bladder exstrophy surgery facilitates immobilization, analgesia and sedation.

Keywords: Bladder exstrophy, epispadius, general anaesthesia, caudal epidural catheter, bupivacaine, fentanyl.

Introduction

Bladder exstrophy is a rare and challenging congenital malformation of the genitourinary system. Classical bladder exstrophy is the most common and affects 1 in 200 000 live births. There is a defect of lower abdominal wall and the anterior wall of the urinary bladder.

The posterior wall of the urinary bladder appears everted with varying degree of pelvic diastasis. [1,2,3,4,5] Surgical reconstruction involves closure of the bladder, posterior urethra, and abdominal wall with pelvic osteotomies. [1,3,4,5]

Multiple procedures are usually necessary in the first year of life. Primary surgical repair requires several hours of surgery with fluid and blood loss. Postoperative intensive care will be required. [3,4,5,6,]

Appropriate patient and pelvic immobilization, sedation, and pain management are essential to prevent distracting forces from separating the repair.

Epidural anesthesia with local anesthetics can provide profound intra- and postoperative analgesia for short duration without impairing respiratory drive. [1]

The use of opioids, preservative-free ketamine, or clonidine as adjuncts results in clinically relevant prolongation of postoperative analgesia.[2]

We present our experience of general anesthesia and caudal epidural infusion for analgesia in 15 patients underwent extrophy-epispadius corrective surgery.

Materials and methods

Fifteen infants and children of either sex, aged 1month - 9years, weighing 3 - 30 kg, ASA physical grade II - IV for major surgical reconstruction of bladder exstrophy - epispadius were operated under combined general and epidural anaesthetic technique.

Surgical procedures done were primary bladder closure, anterior abdominal wall closure, pelvic osteotomy, bladder neck repair, ureteric reimplantation, epispadias repair and vaginal reconstruction. No patients had local infection at caudal region, neurological disorder, history of allergic reaction to local anaesthetics and coagulation disorders.

Written and informed consent was obtained from parents. Pre-operative evaluation of all children were done before workshop and investigations including CBC, RFT, LFT, X-ray chest, X ray sacrum ECG and 2D echo were done. In the operation theatre two IV lines were secured and ECG, NIBP, temp., SpO_2 and $ETCO_2$ were monitored. All patients were premedicated with inj. glycopyrrolate 0.004mg/kg IV. Induction of anesthesia was done with IV inj. sodium thiopental 5-7mg/kg or O_2 (50%), N_2O (50%) and sevoflurane (2-7%). Tracheal intubation was facilitated by IV inj. succinyl choline 1.5-2mg/kg.

Trachea was intubated with proper size portex, cuffed/uncuffed ET tube. Anaesthesia was maintained with O_2 (50%), N_2O (50%), Sevoflurane (0.6-2%) and IV inj. atracurium 0.5mg/kg bolus and 0.1mg/kg incremental dosage.

Under aseptic precaution caudal block was performed in left lateral position, using 18 or 20 gauge tuohy needle and 22 or 24 gauge epidural catheter was inserted. Child with congenital sacral anomaly epidural space was located by lumber approach. The length of the catheter introduced was decided by measuring the length from caudal space to the required level of epidural block. Epidural catheter was secured by looping the catheter at the entry site and covering with a clean plastic dressing,

then routed over the shoulder and fixed to the skin with micropore tape.

Initial bolus 0.75 ml/kg of 0.125% bupivacaine with fentanyl 1µg/kg with maximum volume of 12 ml was administered after negative aspiration for CSF and blood with continuous ECG monitoring. Top-up, half the initial doses of 0.125% bupivacaine were administered after 2-3hours or according to the hemodynamic changes to surgery. Heart rate, NIBP, SpO_2, $EtCO_2$ and temperature were recorded at 15mins. interval till the end of surgery and every hourly interval postoperatively. At the end of surgery neuromuscular block were reversed with neostigmine 0.05mg/kg and glycopyrrolate 0.004mg/kg IV.

Intraoperatively dextrose saline, normal saline, isolyte P, ringer lactate infused @ 10-15 ml/kg/hour. Moderate to major blood loss was replaced with transfusion of blood products.

Postoperative epidural analgesia was maintained by continuous infusion of 0.0625% bupivacaine @ 0.1ml/kg/hr. in young children and 0.125% bupivacaine with fentanyl 1µg/kg in older children. Infusion reta was reduced in 48hours and continued for 4-5days.

Duration of surgery, duration of anesthesia preparation time (time measured from patient's arrival in the operating room to anesthesia ready time) and perioperative complications like brady/tachycardia, hypo/hypertension, tachypnes/bradypnea, desaturation, hypothermia/hyperthermia and vomiting were recorded.

Post-operative sedation was assessed by using four point sedation score (0-spontaneous eye opening, 1-eye opening on speech, 2-eye opening on shake, 3-unarousable) and pain was evaluated by using FLACC score (maximum score of 10 and Score > 4 rescue analgesic) at one hour interval for first three hours and thereafter every 2 hours interval. (Table 1)

In this study collected data were presented as mean ± SD. Statistical calculations were carried out using Microsoft Office Excel 2007.

CATEGORIES	SCORING 0	SCORING 1	SCORING 2
FACE	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
LEGS	Normal position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
ACTIVITY	Lying quietly, normal position moves easily.	Squirming, shifting back and forth, tense	Arched, rigid or jerking
CRY	No cry, (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
CONSOLABILITY	Content, relaxed	Reassured by occasional touching hugging or being talked to, distractable	Difficulty to console or comfort

Table 1. FLACC Score

Results

Fifteen infants and children underwent exstrophy – epispadius surgery. Demographic details age, weight, sex, anaesthesia preparation time, duration of surgery and congenital sacrococcygeal anomaly are presented in Table 2.

Patients characteristic	Range	Total (No=15)	mean±SD
Age (months)	01-05	05	52.75±38.2
	06-12	05	
	13-110	05	
Weight (kg.)	03-10	10	11.53±9.1
	11-20	01	
	21-30	04	
Sex (male:female)	Male	12	
	Female	03	
Anesthesia preparation time (minutes)	20-35	-----	27.73±4.58
Duration of surgery (hours)	5-7	------	5.83±0.62
Preoperative. Sacrococcygeal anomaly	-----	03	

Table 2. Demographic data

Diagnosis and surgical procedure are shown in Table 3.

Diagnosis	Surgery	N= 15
Primary bladder extrophy	Complete Primary Repair of extrophy with bilateral pelvic osteotomy	10
Failed bladder extrophy	Redo Complete Primary Repair of extrophy	02
Epispadius	Extrophy repair and epispadius repair	03

Table 3. Diagnosis and surgical procedures

Complete Primary Repair of extrophy with bilateral pelvic osteotomy was done in 10patients.

The caudal epidural space was identified in first or second attempt. In three young children 18gauge epidural needle with 20gauge epidural catheter and in 12 small children 20 gauge epidural needle with 24gauge epidural catheter was used. Vascular puncture occurred in one child. There was no dural puncture and difficulty in feeding the catheter in any patient. (Table 4)

	Size	N=15
Epidural needle size (gauge)	18	04
	20	11
Epidural catheter size (gauge)	20	04
	24	11
Complications	Vascular puncture	01
	Dural puncture	00

Table 4. Caudal epidural details

Patients remained hemodynamically stable except occasional bradycardia. Anticholinergics were given when pulse rate slowed to less than 100 beats per min. No change in systolic blood pressure was observed.

In thirteen patients epidural infusion was continued for 4days and in two patients for five days. Epidural infusion of bupivacaine was done in ten patients and bupivacaine with fentanyl in five patients. Infusion rates reduced in the first 48 hours in all patients. Thirteen patients were extubated after completion of the surgery. Two patients required mechanical ventilation. Four patients were observed for 2-4 days in neonatal surgical ICU. Signs/symptoms of meningitis or catheter- induced systemic infection were not present. (Table 5)

	Days	N= 15
Duration of epidural catheter (days)	4	13
	5	02
Postoperative Epidural infusion	Bupivacaine	10
	Bupivacaine and fentanyl	05
Extubation in the operating room	Yes	13
	No	02
Postoperative ICU stay duration (days)	2	02
	3	01
	4	01
Postoperative ventilator duration (days)	1	01
	2	01

Table 5. Postoperative analgesia and recovery

For initial 12hours mean FLACC scale was zero. Thereafter up to 120 hours scale remained between 0.5 - 2.4. (Figure 1)

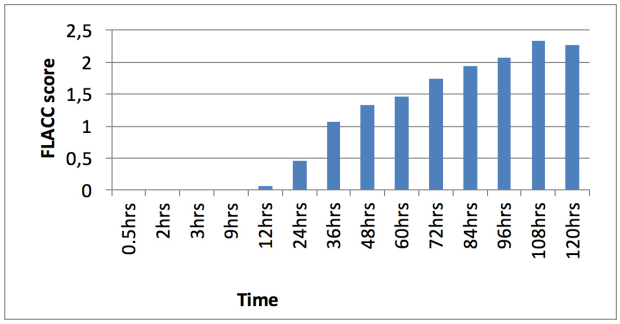

Figure 1. Flacc score

Postoperative mean sedation score in all patients was less than two. (Figure 2)

Figure 2. Sedfation socre

Discussion

Fifteen bladder exstrophy/epispadius patients operated in a workshop under general anesthesia with epidural analgesia via epidural catheter. In recent years general anesthesia with epidural analgesia for exstrophy-epispadias complex is a popular technique. [1,3] Management of exstrophy of the bladder requires the involvement of a team of neonatologist, paediatric surgeons, neonatal anaesthesiologists with relevant associated equipment, neonatal intensive care unit and nursing staff. [1,3,4,6]

An appropriate age for surgery may be between 1 - 3 months of age, but surgery can be done from the first day of life. [4] In newborns initial closure, slightly older infants delayed closure and in children with failed initial closures for repeat repairs are done. [3,6]

Ten infants and five children were operated in our workshop. Complete primary repair of exstrophy with bilateral pelvic osteotomy was done in ten patients, redo complete primary repair of exstrophy in two and extrophy/epispadias repair in three patients.

The dermatomes for bladder extrophy surgery reach from the low thorax to the sacrum. Catheters can be placed in the sacral caudal region or lumbar region. [3,6] Continuous caudal block is a simple and safe technique. [7] Catheter in our cases was introduced by measuring distance from sacral hiatus to lower thoracic segment. No difficulty was faced while threading the catheter except in one patient there was vascular puncture. Threading of a catheter in caudal space is easier due to low density of areolar tissue.

There is high incidence of associated spinal abnormalities like cloacal exstrophy. Imaging should be undertaken before considering central neuraxial block.[2] If epidural placement is not possible in patients with anomalies of the spine intravenous PCA can be used for pain control and to assist with sedation.[1] Three patients in our workshop had congenital sacrococcygeal anomaly in which catheters was placed through lumber region. Average duration of surgery was 5.83 hours and all patients required blood transfusion. In new born primary surgical repair requires several hours of surgery with fluid and blood loss. Adequate venous access and invasive vascular monitoring is recommended.[2]

The postoperative care after bladder exstrophy surgery is pain control and maintenance of immobilization. Epidural analgesia has advantages of giving excellent pain control, alert child, less postoperative nausea and vomiting and minimal physiologic alterations.[1] In combination with general anaesthesia, continuous caudal block provides balanced anaesthesia and satisfactory postoperative analgesia.[7] Some studies had mentioned duration of postoperative epidural infusions range from 8-42days [1] and 4-30 days.[8] In our small series epidural analgesia was continue safely for 4-5days only. Thereafter systemic analgesic was given. Intraoperatively epidural bolus of bupivacaine with fentanyl was given. Postoperatively analgesia was provided by infusion of bupivacaine in infants and bupivacaine and fentanyl in young children. Epidural continuous local anesthetic infusions alone or with opioids has been advocated to provide postoperative analgesia with minimal systemic side effects like sedation, respiratory depression.[1,3,6,8]

Lidocaine 1 mg/mL at a rate no higher than 0.8 mg/kg/hour is recommended in the newborn because it is less toxic. [1,9] It can provide safe analgesia for up to a month in neonates.[8]

No information concerning a safe dose of bupivacaine or ropivacaine administered in epidural infusions is available for neonates and young infants.[10,11] For children less than 4 months infusion rate of 0.2mg/kg/hour and more than 4months infusion rate of 0.4mg/kg/hour reported good safety. [12,13]

Bupivacaine has longer duration of action with slightly greater sensitivity of sensory block compared to motor block.[12] Mild motor block due to epidural analgesic infusion is desirable for children requiring prolonged immobilization and orthopedic traction.[1,6]

After continuous epidural infusion of 0.2 mg bupivacaine, plasma free concentrations remain

relatively unchanged at 1 and 24 hours [10] and associated with rising serum levels after 2 days of infusions in the youngest patients. [10,11]

Combination of opioids with local anesthetics is used to maximize pain relief. (Yaster, Andresini, & Krane, 1997) [1,3] Opioids act by binding to opioid receptors in the dorsal horn of the spinal cord, and via transport though CSF and blood to both cerebral and peripheral opioid receptors. [12] Opioids can cause nausea, vomiting, respiratory depression, pruritis, sedation, urinary retension and constipation. Cucchiaro and colleages found that replacing epidural fentanyl with clonidine resulted in comparable analgesia with fewer side effects. [12] Postoperative analgesia was assessed by FLACC scale in all patients. FLACC scale is moderately reliable for patients with 5-16 years of age.[13]

Continuous epidural therapy can cause toxicity of local anesthetics.[1] In the neonate, postoperative epidural infusions of local anesthetics have been limited to the first 2 or 3 days.[9] Neonates and young infants have reduced albumin and α1 acid glycoprotein, delayed maturation of hepatic enzyme system, so susceptible to local anesthesia toxicity.[9,12]

Complications like hemodynamic disturbances resulting in acidosis and profound hypoxia, respiratory depression in response to sedatives and opioid analgesia and increase risk of blood loss during pelvic osteotomy are seen during exstrophy surgery.[3,6] Two patients in our workshop required postoperative ventilator support due to respiratory depression and other two patients having excessive blood loss were shifted to ICU for vasopressor support and observation.

Epidural analgesia with general anesthesia have advantages of avoiding use of parenteral opioids, reduce requirements of inhalational anaesthetic agents, lack of hemodynamic response to surgical manipulation [7] and allows early tracheal extubation.[14,15] Caudal analgesia suppresses the metabolic and endocrine stress responses, decreases blood glucose and catecholamine concentration and also suppress increase in blood insulin, cortisol and growth hormone concentration.[16]

Serious systemic and local infection after short-term epidural analgesia did not occur. [17] We had fixed catheter at entry site with adhesive plastic dressing. None of our patient had serious systemic or local infection.

Compared to the previously published articles, we kept epidural catheter for shorter durations with satisfactory analgesia, good surgical outcomes. It is very cost effective on medical care of these children, requires less invasive therapy for prolonged periods of time and less likelihood of infections related to prolonged epidurals.

Conclusion

Perioperative anesthetic and analgesic management of the bladder exstrophy patient can improve the success rate. Epidural bupivacaine with or without fentanyl infusions for short duration can provide safe analgesia without any complications.

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References

1. Lori J. Kozlowski. The acute pain service nurse practitioner: A case study in the postoperative care of the child with bladder exstrophy. Journal of Pediatric Health Care 2008;22:351-359.
2. Monika Gandhi, Rita Vashisht. Anaesthesia for paediatric urology. Contin Educ Anaesth Crit Care Pain 2010;10:152-157.
3. Eric Z Massanyi1, John P Gearhart, Sabine Kost-Byerly. Perioperative management of classic bladder exstrophy. Research and Reports in Urology 2013;5:67–75.

4. William Appeadu-Mensah, Piet Hoebeke. Bladder Exstrophy and Epispadias. Paediatric Surgery: A Comprehensive Text For Africa. www.global-help.org/publications/books/help_pedsurgeryafrica92.pdf
5. Veereshwar Bhatnagar. Bladder exstrophy: An overview of the surgical management. J Indian Assoc Pediatr Surg 2011;16: 81–87.
6. Eric Z Massanyi, John P Gearhart, Sabine Kost-Byerly. Perioperative management of classic bladder exstrophy. Research and Reports in Urology 2013;5:67–75.
7. Neha Shah, Kavita Lalwani, M. R. Upadhyay et al. Continuous caudal block : role in paediatrics. Indian journal of anaesthesia 2003;47: 120-121.
8. Sabine Kost-Byerly, Eric V. Jacksona, Myron Yaster et al. Perioperative anesthetic and analgesic management of newborn bladder exstrophy repair. Journal of Pediatric Urology 2008;4:280-285.
9. Kost-Byerly S, Jackson EV, Yaster M et al. Perioperative anesthetic and analgesic management for newborn bladder exstrophy repair. J Ped Urol. 2008;4:280–285.
10. Larsson, B. A, Lonnqvist, P. A, Olsson, G. L. Plasma Concentrations of Bupivacaine in Neonates After Continuous Epidural Infusion. Anesth Analg. esia 1997;84:501-505.
11. Larsson BA, Lönnquist PA, Olsson GL. Plasma concentrations of bupivacaine in neonates after continuous epidural infusions. Anesth Analg 1997;84:501-505.
12. Christine Greco, Navil Sethna, Frances Kraemer. Pediatric Epidural Workshop - The Society for Pediatric Anesthesia. Epidural analgesia has widespread use in infants and children for www2.pedsanesthesia.org/.../Pediatric%20Epidural%20Workshop.pdf
13. Nilsson S, Finnström B, Kokinsky E. The FLACC behavioral scale for procedural pain assessment in children aged 5-16 years. Paediatr Anesth 2008; 18:767-74.
14. Aadrian t. Bo senberg. Epidural analgesia for major neonatal surgery, paediatric anaesthesia1998;8: 479-483.
15. Joseph D Tobias, Gail E Rasmussen, George W Holcomb. Continous caudal anesthesia with chlorprocaine as an adjuvant to general anesthesia in neonates. Can J Anaesth 1996;43:69-72.
16. Tadashi Nakamura, Mayumi Takashaki. Metabolic and endocrine responses to surgery during caudal analgesia in children. Can J Anaesth 1991;38:969-973.
17. Sabine Kost-Byerly, Joseph R. Tobin, Robert S. Greenberg et al. Bacterial Colonization and infection rate of continuous epidural catheters in children. Anesth Analg 1998;86:712-6.