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Pediatric caudal analgesia*

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Summary

Few advancements in postoperative pain control in children have been made despite longstanding inadequacies in conventional analgesic regimens. This study prospectively focuses on the safety, efficacy, and complication rate of caudal analgesia in 168 children following lower abdominal, perineal, or lower extremity surgery. The caudal puncture using 0.25 % bupivacaine was done under general anesthesia prior to the start of the surgical procedure.

The effects of caudal analgesia on peroperative anesthetic agent requirements, recovery time and quality, postoperative analgesic supplementation and outpatient discharge times were found to be beneficial. It was concluded that the use of caudal analgesia to supplement general anesthesia and to provide postoperative pain relief is advantageous for the pediatric outpatient.

Key words: *Pediatric anesthesia, regional anesthesia, caudal anesthesia.*

Introduction

Despite the ancient belief that pediatric patients seldom need relief of pain after surgery, modern pediatric anesthetic management emphasizes that satisfactory analgesia is an essential and achievable goal in the management of children after surgery.

Outpatient anesthesia has gained great popularity in pediatric practice because of shortening the hospitalization time leading to less psychological trauma of seperation from parents as well as a reduced risk of nasocomial infection. Caudal analgesia, being technically very easy to perform, having a low complication rate and providing excellent per. & postoperative analgesia is a worldwide accepted method of choice to serve this goal. The safety, efficacy and complication rate of caudal analgesia, as well as its effects on peroperative inhalational agent requirements, recovery time and quality, postoperative analgesic supplementation and outpatient discharge times were aimed to be evaluated in this prospective study.

Material and Methods

168 otherwise healthy infants and children scheduled for lower abdominal, perineal or lower extremity surgery were included in the study. The mean age was 2.8±1.9 yrs (2 days-11 yrs), the mean body weight was 13±7.4 kg (3.2-33 kg) (Table I).

Children were asked to refrain from ingesting solid food for 6 hours and clear fluids for 2 hours before the induction of anesthesia. Premedication consisted of atropine sulphate 15 µg/kg given intramuscularly an hour prior to the induction. Anesthesia was induced in all patients with 0.5 %-3 % halothane and 70 % N_2O in O_2 through a face mask. After loss of consciousness, vascular access was obtained and muscle relaxation was provided with succinylcholine 1.5 mg/kg intravenously.

Once the airway was secured, either with a face mask (FM), a laryngeal mask airway (LMA) or an endotracheal tube (ETT), the patients was turned on one side with the knees maximally flexed to the chest.

Having prepared the area with prewarmed iodine solution, the sacral hiatus was identified and the sacrococcygeal ligament was punctured with a 23 gauge syringe needle. The correct placement of the needle was confirmed with a negative aspiration test

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Table I. Patient characteristics and technical data

Age (years; mean±SD)	2.8±1.9
Body weight (kg; mean±SD)	13±7.4
Anesthetic duration (min; mean±SD)	66±28
Surgical duration (min; mean±SD)	52±31
Time for caudal (min; mean±SD)	4.2±1.7
Ventilation (n) FM	3
LMA	95
ETT	70

FM: face mask, LMA: laryngeal mask airway, ETT: endotracheal tube.

Table II. Data related to caudal puncture

1 attempt (n)	108 (64 %)
2 attempts (n)	48 (29 %)
Successful caudal block (n)	156 (93 %)
3 attempts (n)	12 (7 %)
Unsuccessful caudal block (n)	12 (7 %)

and the local anesthetic solution was injected. 0.25 % bupivacaine was used in all caudal blocks. 0.5 ml/kg of the local anesthetic solution was given for operations of the sacral dermatomes, 1 ml/kg for lumbosacral dermatomes and 1.25 ml/kg for thoracolomber dermatomes. When the total injection volume was greater than 20 ml, 0.19 % bupivacaine was used.

Anesthesia was maintained with 0.2 %-1.2 % halothane and 70 % N_2O in 30 % O_2. Heart rate, noninvasive blood pressure, SpO_2, $ETCO_2$ and inhalational anesthetic concentration were continuously recorded. At the conclusion of the surgical procedure, anesthesia was discontinued and the patient was transferred to the recovery room. Here the nurse in charge assessed the need for analgesic drugs and monitored the recovery of the patient. If deemed necessary meperidine 1 mg/kg was given intravenously. The incidence of postoperative morbidity was recorded. The child was discharged home when fully awake and stable. Unpaired Student-t test was used for statistical comparison, $p<0.05$ was considered significant.

Results

Mean anesthetic duration was 66±28 min (24-132 min), mean surgical duration was 52±31 min (18-119 min). The time required for caudal injection was found to be 4.2±1.7 min (2.5-16 min) (Table I). Ventilation was provided with a FM in 3 patients, with a LMA in 95 patients and an ETT in 70 (Table I). A total of 240 caudal puncture attempts were done in 168 patients. 108 patients were successfully blocked at the first attempt (64 %), whereas in 48 block could be achieved at the second attempt (29 %). The block was abandoned in 12 patients after the third attempt, in 9 because of subcutaneous infiltraton and in 3 due to bloody aspiration test (Table II).

Peroperative inhalational agent concentration was found to be 0.4 % (0.1 %-0.6 %) in the successfully blocked group, whereas it was 0.8 % (0.5 %-1.2 %) in the unsuccessful block group ($p<0.05$). Full recovery and discharge times were found to be 21±11 min for the successfully blocked group, whereas it was 66±14 min for those in whom the block was unsuccessful ($p<0.05$). No patient from the successfully blocked group needed supplemental analgesics in the recovery room. All patients where the block was unsuccessful were given meperidine 1 mg/kg intravenously.

The incidence of postoperative nausea was 9 % in the successfully blocked group; it was found to be 66 % in the unsuccessful group ($p<0.05$). In those children where the block was successful, 2 (1 %) had unilateral and 6 (3.8 %) had bilateral motor block diagnosed at the conclusion of surgery, all resuming during the early postoperative period. 1 patient (0.6 %) was readmitted to the hospital with meningeal irritation symptoms on the first postoperative day; but was fortunately discharged a week later in perfect physical condition.

Discussion

Until recently, it had been assumed that pediatric patients tolerated pain well and had less requirements for analgesia, especially neonates and infants. Doubts had persisted largely as a result of the lack of reliable ways of ascertaining pain perception in this latter group. The question of whether there are biological differences between various age groups is still largely unanswered. Early research emphasised the incomplete myelination of afferent nerves, implying that children would respond differently to noxious stimuli and some even questioning whether in-

fants experienced pain at all. However more recent studies using spectrographic analysis of infant cries, physiologic responses to circumcision and standardised behavioural observation of children undergoing medical procedures all report that infants and young children clearly experience pain [15,17,18,24,31].

Satisfactory analgesia is both an essential and achievable goal in the perioperative management of children; yet, under treatment of perioperative pain occurs very frequently in children despite the wide range of available therapy [21,26]. Effective systemic analgesia can be achieved safely and simply even in newborns, but requires modification from adult dosage regimes to compensate for pharmacokinetic and pharmacodynamic variation with maturity [5]. On the other hand, all the widely used analgesics may result in increased incidence of nausea and vomiting together with drowsiness, symptoms especially undesirable for the outpatient [13].

In this respect, regional techniques have gained great popularity in pediatric anesthetic practice during the last two decades [10,33]. Caudal block has its special place among all these techniques for two reasons. First, it is simple to perform because of the ease with which the sacral hiatus can be palpated in most children. Second, cephalad spread of local anesthetic solutions is very reliable and predictable in children due to the constitution of loose and gelatinous epidural fat [3,8,27]. Caudal epidural block is perceived to provide the patient with intraoperative as well as postoperative benefits. Intraoperatively, it allows general anesthesia to be maintained with reduced doses of anesthetic agents which leads to a faster and smoother recovery [1].

In our study, intraoperative inhalational agent concentration was found to be 0.4 % in the successfully blocked group leading to a full recovery and discharge time of 21 min, whereas these were found to be 0.8 % and 66 min consequtively in those patients where the block had been unsuccessful. Postoperatively, caudal block can provide effective analgesia without the use of narcotics. A single bolus of local anesthetic given by this route may provide effective postoperative analgesia for up to 24 hours [30]. In our study, no patient from the successfully blocked group needed supplemental analgesics in the recovery room whereas all patients where the block was unsuccessful were given meperidine 1 mg/kg intravenously.

Bupivacaine is the principal local anesthetic used for caudal blockade in children because of its prolonged duration of action [4,20,29]. 0.25 % bupivacaine has been recommended as the optimal effective concentration [6,16]. Yet if epinephrine is to be added to the local anesthetic solution to prolong postoperative analgesia, 0.125 % bupivacaine should be the concentration of choice providing similar postoperative analgesia and being associated with less motor blockade [32]. The number of different dosage schedules that have been proposed for caudal blockade in children would seem to indicate that none are entirely satisfactory [2,7,8,12,14,16,25,27,28,30].

Armitage scheme which recommends volumes of 0.5 ml/kg for blockade of sacral nerves, 1.0 ml/kg for blockade of lower thoracic nerves, and 1.25 ml/kg for blockade of midthoracic nerves is the most commonly employed dosage regime for 0.25 % bupivacaine [2]. We therefore took the liberty of employing this regime in our study. Caudal block has a low incidence of serious side effects in children [9]. Potentially serious complications are subarachnoid, intravascular or intraosseous injection of the local anesthetic solution and needle trauma to nerves and other tissues; however, these complications are rare [11,22]. In our study, 1 patient was readmitted to the hospital with meningeal irritation symptoms on the first postoperative day presumably due to an inadvertent dural penetration during the caudal puncture attempt.

The reported incidence of nausea and vomiting is 5 % to 30 % which does not seem to be less in patients who have received narcotics [9,10,19,23,34]. The incidence of nausea was found to be 9 % in our patients with successful caudal blocks. Since all of these patients have received a general anesthetic as well as a caudal block, it is often difficult to apportion the blame for this complication. Yet, taking into account that the incidence of nausea was 66 % in those patients where the block had been unsuccessful, it wouldn't be unfair to blame increasing concentrations of general anesthetics as the primary cause.

Leg weakness from residual motor block has a reported incidence of 5 % to 31 % which was found to be 5.1 % in our study [29,32,34]. Since this complication is directly related to the concentration of local anesthetic used, it can be diminished by using lower concentrations. A number of investigators have stated that urinary retention due to decreased bladder sensation is common up to 10 hours into the postoperative period, but this is rarely a serious problem unless higher concentrations of local anesthetic is used [29,34].

In conclusion, caudal block being technically very easy to perform, having a low complication rate, enabling a lighter anesthetic level leading to a somother and faster recovery and providing excellent per. & postoperative analgesia deserves to be a routine application in pediatric outpatient anesthetic management.

References

1. Armitage EN: Caudal block in children. Anaesthesia 34:396, 1979
2. Armitage EN: Regional anesthesia in paediatrics. Clin Anaesthesiol 3:553, 1985
3. Bösenberg AT, Bland BAR, Schult Steinberg O, Downing JW: Thoracic epidural anaesthesia via caudal route in infants. Anesthesiology 69:265, 1988
4. Bramwell RGB, Bullen C, Radfoed P: Caudal block for postoperative analgesia in children. Anaesthesia 37:1024, 1982
5. Bray RJ: Postoperative analgesia provided by morphine in children. Anaesthesia 38:1075, 1983
6. Broadman LM, Hanallah RS, Norrie WC, et al: Caudal analgesia in pediatric outpatient surgery: A comparison of three different bupivacaine concentrations. Anesth Analg 66:S19, 1987
7. Bromage PR: Ageing and epidural dose requirements-segmental spread and predictability of epidural analgesia in youth and extreme age. Br J Anaesth 41:1016, 1969
8. Busoni P, Andreuccetti T: The spread of caudal analgesia in children: A mathematical model. Anaesth Intens Care 14:140, 1986
9. Dalens D, Hasnaoui A: Caudal anaesthesia in pediatric surgery: Success rate and adverse effects in 750 consecutive patients. Anesth Analg 68:83, 1989
10. Dalens B: Regional anesthesia in children. Anesth Analg 68:654, 1989
11. Desparmet J: Total spinal anesthesia after caudal anesthesia in an infant. Anesth Analg 70:665, 1990
12. Ecoffey C, Desparmet J, Maury M, et al: Bupivacaine in children: Pharmacokinetica following caudal anesthesia. Anesthesiology 63:447, 1985
13. Goodman LS, Gilman A: The Pharmacological Basis of Therapeutics. 8th edition. New York, Pergamon, 1990, p.498
14. Hain WR: Anaesthetic doses for extradural anaesthesia in children. Br J Anaesth 50:303, 1978
15. Jay SM, Ozolins M, Eliot CH, et al: Assessment of children's distress during painful medical procedures. Health Psychol 2:133, 1983
16. Kapsten JE, Broadman LM, Hanallah RS, et al: Is there an optimum concentration of bupivacaine for caudal analgesia in outpatient surgery for children? Can Anaesth Soc J 33:S144, 1986
17. Katz ER, Kellerman J, Siegal SE: Behavioral distress in children with cancer undergoing medical procedures: Developmental considerations. J Consult Clin Psychol 48:356, 1980
18. Levine DJ, Gordon NC: Pain in prelingual children and its evaluation by pain-induced vocalisation. Pain 14:85, 1982
19. Lunn JN: Postoperative analgesia after circumcision. A randomized comparison between caudal analgesia and intramuscular morphine in boys. Anaesthesia 34:552, 1979
20. Martham SJ, Tomlinson J, Hain WR: Ilionguinal nerve block in children. A comparison with caudal block for intra and postoperative analgesia. Anaesthesia 41:1091, 1986
21. Mather L, Mackee J: The incidence of postoperative pain in children. Pain 15:271, 1983
22. Matsumiya N, Dohi S, Takahashi H, et al: Cardiovascular collapse in an infant after caudal anesthesia with lidocaine-epinephrine solution. Anesth Analg 65:1074, 1986
23. May AE, Wandless J, James RH: Analgesia for circumcision in children: A comparison of caudal bupivacaine and intramuscular buprenorphine. Acta Anaesthesiol Scand 26:31, 1982
24. Owen ME, Todt EH: Pain in infancy: Neonatal reaction to a heel lance. Pain 20:77, 1984
25. Satoyoshi M, Kamiyama Y: Caudal anaesthesia for upper abdominal surgery in infants and children: A simple calculation of the volume of local anesthetic. Acta Anaesthesiol Scand 28:57, 1984
26. Schecter NL: Status of pediatric pain control. Pediatrics 77:11, 1986
27. Schulte-Steinberg O, Rahlfs VW: Spread of extradural analgesia following caudal injection in children. Br J Anaesth 49:1027, 1977
28. Schulte-Steinberg O: Regional anaesthesia in children. Ann Chir Gynaecol 73:158, 1984
29. Vater M, Wandless J: Caudal or dorsal nerve block? A comparison of two local anesthetic techniques for postoperative analgesia following day care circumcision. Acta Anaesthesiol Scand 29:175, 1985
30. Warner MA, Kunkel SE, Offord KO, et al: The effect of age, epinephrine, and operative site on duration of caudal analgesia in pediatric patients. Anesth Analg 66:995, 1987
31. Williamson PS, Williamson ML: Physiologic stress reduction by a local anesthetic during newborn circumcision. Pediatrics 71:36, 1983
32. Wolf AR, Valley RD, Fear DW, et al: Bupivacaine for caudal anesthesia in infants and children. The optimal effective concentration. Anesthesiology 69:102, 1988
33. Yaster M, Maxwell LG: Pediatric regional anesthesia. Anesthesiology 70:324, 1989
34. Yeoman PM, Cooke R, Hain WR: Penile block for circumcision. A comparison with caudal block. Anaesthesia 38:862, 1983