The management of postoperative pain in children with caudal blocks

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Abstract

Background: The aim of this study was to evaluate the pre-emptive analgesic effect and duration of postoperative analgesia after caudal blocks in children.

Method: Forty-five children undergoing distal hypospadias surgery were assigned to group 1 (n = 23), and received caudal 0.25% bupivacaine 0.5 mg/kg and midazolam 0.05 mg/kg before the surgical incision. Group 2 (n = 22) received caudal 0.25% bupivacaine 0.5 mg/kg and midazolam 0.05 mg/kg at the end of surgery. Anaesthesia was induced with propofol and fentanyl and maintained with sevoflurane and nitrous oxide. Postoperative pain was rated on an objective paediatric pain scale.

Results: The analgesic requirement was greater in the second group.

Conclusion: Pre-emptive analgesia with caudal blocks may prevent the intensity and frequency of postoperative wound pain.

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Introduction

Pre-emptive analgesia involves the introduction of an analgesic before the onset of noxious stimuli. Prevention of the initial neural cascade could lead to eliminating the hypersensitivity produced by noxious stimuli.[1-3] One of the techniques for prevention of postoperative pain in children involves the use of a caudal block.

Single-shot caudal epidural blockade is one of the most widespread techniques used to provide intra- and postoperative analgesia in paediatric patients, and it is relatively easy to perform.[4-6] Caudal block may be performed prior to surgery in combination with general anaesthesia, after surgery for postoperative analgesia, or instead of general anaesthesia for low abdominal and lower extremity procedures.[7]

The aim of this study was to evaluate the pre-emptive analgesic effect and duration of postoperative analgesia after caudal blocks with bupivacaine and midazolam, given before or after surgery, to children undergoing surgical treatment for hypospadias.

Method

This prospective, randomised, double-blinded study was approved by our institution's ethics committee, and written informed consent was obtained from the parents of each participant. The subjects were 45 boys aged one to nine years. All were American Society of Anesthesiologists (ASA) physical status I or II. Each patient was assigned randomly to one of two groups, once for each operation. Patients were excluded if they had a known allergy to any of the drugs involved in the study, those with ASA physical status above II, and if the caudal block failed.

Each child was premedicated with oral midazolam (0.5 mg/kg) 30 minutes before anaesthesia induction. The intravenous line was introduced in both groups of children before the induction of anaesthesia. Anaesthesia was induced with propofol and fentanyl and a laryngeal mask

was inserted. Anaesthesia was maintained with sevoflurane in 50% nitrous oxide and oxygen (O_2). After induction, in the lateral decubitus position, a 22-gauge intravenous catheter was inserted in the caudal space. Patients in group 1 (n = 23) received 0.25% caudal bupivacaine 0.5 mg/kg and midazolam 0.05 mg/kg before the surgical incision, and patents in group two (n = 22) received 0.25% caudal bupivacaine 0.5 mg/kg and midazolam 0.05 mg/kg at the end of surgery.

Pressure-controlled ventilation was administered throughout the operation. Anaesthesia was discontinued after the last suture was tied. The laryngeal mask was removed when the child was breathing spontaneously (on 100% O_2) and airway reflexes were restored.

In each case, heart rate, blood pressure, arterial O_2 saturation, and end-tidal carbon dioxide (CO_2) concentration (Compact 5XL, Medical ECONET, Germany) were recorded at fixed intervals throughout the operation.

In order to keep the study double-blinded, two separate anaesthesiologists were involved in each case. The first blinded anaesthesiologist collected the following data: age, weight, premedication, preoperative anxiety, type of anaesthesia, type of surgery, and duration of surgery and anaesthesia. The anaesthesiologist was blinded to the specificity of the caudal solution. In the post-anaesthesia care unit, the second anaesthesiologist, blinded as to the specificity of caudal solution, observed and collected the following data: recovery time, pain and adverse effects.

The Objective Pain Scale (OPS; minimum score: 0 = no pain, maximum score: 10 = extreme pain) was used to assess pain severity.[8] This scale is composed of five items and each was scored (Table I). Assessments were made at 15-minute intervals for the first hour, 30-minute intervals for the second hour, and at three, four, five, six and 24 hours after recovery from anaesthesia. The observer scored pain at each time point [none/insignificant pain (1–3), moderate pain (4–6), severe pain (7–10)]. Patients with pain score equal to or greater than 4 were treated with an additional dose of analgesics. Patients with pain score at least 4 received diclofenac suppository (1–2 mg/kg).

Recovery time (defined as the time until eye opening on command or the time of first response to command after anaesthesia), preoperative anxiety, agitation during the emergence period and time to first analgesia administration were also noted. Preoperative anxiety was assessed (after premedication until the anaesthetic induction) using an observational scale, the modified Yale Preoperative Anxiety Scale (YPAS-m).[9] The child was considered anxious if the YPAS-m score was greater than 30.

Table I: Objective Pain Scale (OPS) for Postoperative Pain Assessment by Hanallah et al[8]

Parameter	Finding	Points
Systolic blood pressure	Increase < 20% of preoperative blood pressure	0
	Increase 20–30% of preoperative blood pressure	1
	Increase > 30% of preoperative blood pressure	2
Crying	Not crying	0
	Responds to age-appropriate nurturing (tender loving care)	1
	Does not respond to nurturing	2
Movements	No movements relaxed	0
	Restless (moving about in bed constantly)	1
	Thrashing (moving wildly)	2
	Rigid (stiff)	2
Agitation	Asleep or calm	0
	Can be comforted to lessen the agitation (mild)	1
	Cannot be comforted (hysterical)	2
Complains of pain	Asleep	0
	States no pain	0
	Cannot localise	1
	Localises pain	2

Adverse effects during surgery, hypotension and bradycardia and after removal of laryngeal mask (intense coughing, hypersalivation, laryngospasm), nausea and vomiting, and muscle weakness were also recorded.

Demographic data (age, sex, weight), duration of surgery, recovery time, preoperative anxiety, intraoperative data and pain were presented as median and percentiles. Differences between the two groups were analysed using paired t tests. Non-parametric data and incidence of adverse events are expressed as median and range, and differences between the two groups were analysed using the Wilcoxon ranked-sum test, exact Fisher test and chi-square test. P-values less than 0.05 were considered statistically significant.

Results

Group 1 (n = 23) represented 51% of the total children in the study and group 2 (n = 22) represented 49%. There were no significant differences between the two study groups with respect to age, weight, proportions of patients with physical status ASA I and II or type of operation, and frequency of preoperative anxiety or emergence agitation (P > 0.05; Table II).

Table II: Demographic data, durations of surgery and anaesthesia, recovery time, frequencies of preoperative anxiety and emergence agitation scores in the two groups. Values are listed as median (percentile), number of patients or mean ± standard deviation

	Group I (n = 23)	Group II (n = 22)
Age (years)	5.0 ± 1.5	5.0 ± 1.6
Weight (kg)	19.4 ± 6.1	19.0 ± 5.7
ASA status (I/II)	12/11	10/12
Duration of surgery (minutes)	40.6 ± 9.0	42.2 ± 11.3
Duration of anaesthesia (minutes)	68.1 ± 23.2	69.0 ± 28.5
Preoperative anxiety n (%)	2 (8.7%)	1 (4.5%)
Emergence agitation	1.3 ± 0.6	1.4 ± 0.7
Recovery time (minutes)	16.1 ± 4.3	15.5 ± 5.4

a = American Society of Anaesthesiologists

Table III lists the frequencies of different adverse effects that were noted in the two groups. Four patients (17.4%) in group 1 and three (13.6%) in group 2 developed hypotension intraoperatively. These differences were statistically significant. None of the 45 children required treatment with vasoactive agents. Motor block was present in only one child in group 1 and one in group 2.

Table III: Side-effects in the two groups

	Group 1 (n = 23)	Group 2 (n = 22)	p-value
Hypotension	4 (17.4%)	3 (13.6%)	0.041*
Bradycardia	5 (21.7%)	5 (22.7%)	0.864
Cough	2 (8.7%)	2 (9.1%)	0.925
Laryngospasm	2 (8.7%)	1 (4.5%)	0.609
Hypersalivation	3 (13.0%)	3 (13.6%)	0.924
Nausea/vomiting	2 (8.7%)	2 (9.1%)	0.817
Muscle weakness	1 (4.4%)	1(4.5%)	0.934

* Statistically significant difference

Table IV shows the results for first requirement of analgesics. The mean time for group 2 was significantly shorter than the corresponding mean for group 1 (4.6 ± 1.3 hours vs. 5.2 ± 2.4 hours respectively; P < 0.01).

Table IV: Results of the postoperative pain score using the Objective Pain Scale (OPS), and incidence and recovery to first analgesic time

	Group 1 (n = 23)	Group 2 (n = 22)	p-value
OPS score (range)	2 (0-10)	8 (0–10)	< 0.01*
Pain n (%)	2 (8.7%)	9 (40.9%)	< 0.05*
Recovery to first analgesic time (hours)	5.2 ± 2.4	4.6 ± 1.3	< 0.01*

* Statistically significant difference

Group 2 had a significantly higher proportion of patients who exhibited postoperative pain than did group 1 (40.9% vs. 8.7% respectively; p-value < 0.05). The OPS score in group 1 was 3 (range, 0–10), whereas the corresponding score in group 2 was 8 (range, 1–10). The difference between these results was statistically significant (p-value < 0.01; Table IV).

Discussion

The theory that pre-emptive analgesic interventions are more effective than conventional treatment in managing acute postoperative pain remains controversial. Several reviews have come to very different conclusions. For example, some reviews have concluded that pre-emptive analgesia is effective,[10,11] but others have concluded it to be effective only for certain analgesic drugs.[1,12] The evidence on pre-emptive analgesia in animal studies is very convincing,[13] but results from human clinical studies remain controversial.

Our study compared preincisional vs. postsurgical administration of caudal block with bupivacaine and midazolam. The results support the effectiveness of pre-emptive analgesia. A significantly higher frequency of postoperative pain was associated with caudal block at the end of surgery (40.9% vs. 8.7% respectively).

Several studies have compared the effect of preoperative and postoperative anaesthesia infiltration for inguinal herniorrhaphy. There is no firm evidence confirming the ideal timing of analgesic treatment to gain optimal postoperative pain control.[14,15]

Katz et al studied patients scheduled for elective thoracic surgery. The study group received epidural fentanyl before the surgical incision, while the control group received the same dose of epidural fentanyl after the incision. They found significantly lower pain scores in patients who were administered epidural block before the surgical incision.[16]

Another study which had similar findings was from Amr et al, who administered preincisional epidural bupivacaine and fentanyl in patients undergoing thoracic surgery and demonstrated a significantly lower postoperative pain score.[17]

Arici et al demonstrated that pre-emptively administered intravenous paracetamol 1 g in patients undergoing total abdominal hysterectomy ensured effective analgesia during the postoperative period and reduced postoperative morphine requirements and side-effects.[18]

Research has established that multiple factors are associated with postoperative pain. Some of the possible causes include anxiety just prior to surgery and emergence

delirium. A number of groups have looked at the correlation between preoperative anxiety, postoperative agitation and postoperative pain. Kain et al evaluated the relationship between preoperative anxiety and both postoperative delirium and new maladaptive behaviours, using data from several previous studies.[19] They found that higher levels of preoperative anxiety put patients at increased risk for postoperative pain. In our study, the data demonstrate a similar incidence of preoperative anxiety and emergence agitation in both the groups 1 and 2. The incidence rates of adverse effects were low in both groups. The findings also revealed a significant difference in time to first analgesia request between the groups.

In summary, postoperative pain in children remains a significant problem. Our results indicate that caudal block administered with bupivacaine and midazolam, before the surgical incision, is associated with lower postoperative pain intensity and reduced postoperative analgesic requirements when compared with caudal block applied at the end of surgery. Therefore pre-emptive analgesia may lessen the intensity and frequency of postoperative wound pain.

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