Original Article

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Caudal Epidural Analgesia in Children: A Comparison Between 0.2% Ropivacaine and 0.25% Bupivacaine

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Abstract

Background: One of the most commonly used anaesthetic procedure in paediatric surgeries is the caudal epidural block. The aim of present study was to compare the effectiveness, duration of analgesia and motor block after a single dose caudal epidural block with either ropivacaine or bupivacaine in children undergoing infra-umbilical surgery. *Methods:* In a prospective, randomized, double blind study, sixty children, American Society Association Grade I-II, aged between 1 yr and 6 yr of both sex undergoing infraumbilical surgeries were randomly allocated into two equal groups of 30 children each to receive a caudal block with either 1 ml/kg, 0.2% ropivacaine (Group R) or 1 ml/kg, 0.25% bupivacaine (Group B). Standard anaesthesia induction was conducted in all children. After induction, caudal epidural block was performed in lateral position. By the end of surgery, reversal of muscle relaxation was done and children were extubated. Perioperative haemodynamic parameters were noted. Postoperatively, pain score, duration of analgesia, requirement of rescue analgesia and degree of motor blockade were recorded. *Results:* No significant differences in demographic data as well as duration of surgery were recorded. Haemodynamics were not different in two groups. Postoperative pain score, duration of analgesia and requirement for rescue analgesic were comparable in two groups. However, degree of motor block was significantly less in ropivacaine group. *Conclusion:* Caudal ropivacaine provides effective analgesia comparable to bupivacaine and as ropivacaine possessing less motor blockade makes it a suitable agent for caudal epidural block in children.

Keywords: Caudal Block; Postoperative Analgesia; Ropivacaine; Bupivacaine.

Introduction

Since long time various regional anaesthetic techniques has acquired popularity for postoperative analgesia because regional techniques provide effective postoperative pain relief and they also reduce the requirement of general anaesthesia intra-operatively. Caudal block has been shown to be safe in various paediatric lower body surgical procedures [1-6]. It is usually combined with general anaesthesia that provides intra-operative anaesthesia and postoperative analgesia.

Bupivacaine has, until, recently been the drug of choice for the caudal epidural block. Unfortunately, bupivacaine induced motor blockade may be a cause of distress to children in the postoperative period. Ropivacaine, a long acting amide local anaesthetic agent, offers a wide margin of safety than bupivacaine, with lower potential for cardiovascular and neural effects [7] and also has less motor blockade and prolonged sensory analgesia than bupivacaine [8]. In children this could allow more rapid mobilization after surgery.

The present prospective, randomized and double blind study was undertaken with aim to compare effectiveness, duration of analgesia, motor block and any side effects after a single dose caudal epidural block with either ropivacaine or bupivacaine in children undergoing infra-umbilical surgery.

Materials and Methods

After institutional ethics committee's approval, sixty children American Society Association Grade I-II aged

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between 1 yr and 6 yr of both sex undergoing infraumbilical surgeries were selected for the study. The children were randomized in a double blind manner using closed envelop method to get enrolled into 2 equal groups: Group R children (n= 30) received single dose caudal epidural block using 0.2% ropivacaine whereas Group B children (n= 30) received single dose caudal epidural block using 0.25% bupivacaine. Exclusion criteria included known or suspected coagulopathy, any congenital anomalies of the sacrum, any infection at the site of injection, known or suspected allergy to any of studied drugs.

Children were kept fasting for water 2 h and light meals for 6 h. On arrival to the operating theatre, all children were premedicated with inj. glycopyrrolate 0.004 mg/kg and inj. midazolam 0.02 mg/kg intravenously. The standard monitors were applied including non-invasive blood pressure, electrocardiography and pulse oximetry. Children were induced using 8% sevoflurane in 100% oxygen, and a 24 G cannula was inserted. Atracurium 0.5 mg/kg was given intravenously and then incubated. Anaesthesia was maintained using sevoflurane 1% and 50% nitrous oxide in oxygen with controlled mechanical ventilation. Thereafter, children were placed in a lateral position and the skin of the back over the sacrum was scrub using povidone iodine solution, and under strict aseptic precautions single dose caudal epidural block was done using 25 G needle. After needle aspiration and negative aspiration of blood or cerebrospinal fluid, children of Group R were given 1 ml/kg, 0.2% ropivacaine whereas children of Group B were given 1 ml/kg, 0.25% bupivacaine. The NIBP, heart rate (HR), and peripheral oxygen saturation (SpO_2) were recorded every 5 min all through the surgery and sevoflurane level was adjusted to maintain the base line arterial pressure and any intraoperative increase of arterial pressure or HR more than 20% of the base line was considered as inadequate analgesia and was managed by fentanyl 1 µg/kg IV. By the end of surgery, reversal of muscle relaxation was done by glycopyrrolate 0.008 mg/kg and neostigmine 0.05 mg/kg intravenously. On return of spontaneous ventilation, children were extubated and shifted to post-anaesthesia care unit (PACU).

Postoperatively, degree of motor blockade was assessed by using modified Bromage scale (Table 1) at 0 and 2 hrs. Pain score was observed and recorded every hour for the first 24 h.

Pain was assessed by the "Face, Legs, Activity, Crying, and Consolability (FLACC) observational pain score instrument [9] (Table 2). Children with pain score >4 were given rescue analgesia of inj. fentanyl 0.5 µg/kg intravenously. Duration of postoperative analgesia was defined to be the time between caudal block administration and first requirement of rescue analgesic. The time to first need for rescue analgesic and total number of supplemental analgesic were also recorded during the first 24 hr postoperative period.

Any side effects including vomiting, itching, respiratory depression (oxygen saturation <95%), hypotension (20% decrease from base line) and bradycardia (HR <60 beats/min) were also recorded.

Data were analysed using Student *t*-test and Chi-square test. P<0.05 was considered to be statistically significant.

Table 1: Modified Bromage scale

Grade	Criteria
0	Free movement of legs and feet
1	Just able to flex knees with free movement of feet
2	Unable to flex knees, but with free movement of feet
3	Unable to move legs or feet

Table 2: FLACC score

Category	Score		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Quivering chin or 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 occasionally	Crying steadily or screams
Consolability	Content, relaxed	Reassured by occasional touching or hugging	Difficult to console or comfort

Results

The current study showed no significant differences in demographic data between the two groups (Table 3). Furthermore, no significant difference was detected between Group R and Group B in the type of surgery as well as duration of surgery (Table 3).

Regarding the vital signs and haemodynamic stability intra-operatively, the recorded arterial pressure and HR showed no statistically significant difference between both groups.

Postoperative pain scores, duration of analgesia were comparable in both groups (Table 4). The number of children who required additional analgesic in first 24 hr postoperative period was statistically similar in two groups (Table 5).

Immediately after surgery, all children showed some amount of motor block. But after two hours 93.3% children had normal motor power (Grade 0) in ropivacaine group as compared to 36.6% children in bupivacaine group (Table 6).

The incidence of postoperative side effects was similar in two groups (Table 7).

Table 3: Patient's characteristics

Variables	Group R	Group B
Age (years)	3.56±1.80	3.40±1.66
Weight (kg)	14.36±3.23	14.47±3.12
Sex (M:F)	25:5	24:6
Type of surgery	4	3
Urethroplasty	19	20
Herniotomy	4	3
Circumcision Orchidopexy	3	4
Duration of surgery (min)	46.06±15.21	46.00±16.02
Duration of post-operative analgesia (min)	7.39±0.91	8.13±0.82

Values are mean ± SD or n

Table 4: Post-operative pain score

Time	Group R	Group B
1hr	0.2±0.5	0.1±0.3
4hrs	0.3±0.4	0.3±0.6
6hrs	1.0±1.3	0.8±1.0
12hrs	4.8±1.0	4.5±1.2
24hrs	6.9±1.3	7.0±1.4

Values are mean ± SD

Table 5: Requirement for additional analgesic during first 24 hrs postoperative period

No. of Doses in 24 hrs	Group R		Group B	
	n	%	n	%
0	23	76.66%	25	83.33%
1	5	16.66%	4	13.33%
2	2	6.66%	1	3.33%
3	0	0%	0	0%

Table 6: Degree of motor block at 2 hr postoperatively

Motor Block	Group R		Group B	
	n	%	n	%
Grade 0	28	93.33%	11	36.66%*
Grade 1	2	6.66%	17	56.66%
Grade 2	0	0%	2	6.66%
Grade 3	0	0%	0	0%

*P<0.001, group R versus B

Table 7: Incidence of side effects

Side effects	Group R		Group B	
	n	%	n	%
Nausea & Vomiting	2	6.66%	3	10.00%
Sedation	3	10.00%	4	13.33%
Urinary Retention	0	0%	0	0%
Respiratory depression	0	0%	0	0%

Discussion

Caudal epidural block is a extensively used procedure for providing regional anaesthesia and analgesia in children undergoing infraumbilical surgery. It is generally considered simple and safe technique. This technique provides analgesia after the surgery with a smooth recovery and good postoperative pain control and therefore reduces analgesic requirement and facilitates early discharge [10].

For many years bupivacaine is commonly used in regional anaesthesia and analgesia but is associated with systemic toxic reactions after accidental intravenous injections and also prolonged motor blockade.

Ropivacaine possesses various characteristics which may be useful in children, namely the potential to produce differential neural blockade with less motor block and reduced cardiovascular and neural toxicity [11]. Its lower intrinsic toxicity and lower mass of drug required gives an increased margin of safety which may be important particularly in younger children [12].

Ivani G et al [13] found that 2 mg/kg of 0.2% ropivacaine is sufficient to obtain sensory block for lower abdominal or genital surgery in children. We have chosen 1 ml/kg, 0.2% ropivacaine because pharmacokinetic studies of ropivacaine show that 1 ml/kg, 0.25% ropivacaine administered caudally produces much lower plasma concentration than the maximal tolerated plasma concentration of ropivacaine in adult volunteers [14,15].

In the present study, we have used 1 ml/kg, 0.2% ropivacaine or 1 ml/kg, 0.25% bupivacaine for single dose caudal epidural block and our results shows that both ropivacaine and bupivacaine provides reliable and long lasting analgesia in children following infraumbilical surgery. Quality and duration of analgesia did not differ significantly between two groups. However, there was a significant difference in the degree of motor block between the two groups at 2 hrs after the completion of surgery as significantly greater number of children in bupivacaine group had grade 1 motor block than in ropivacaine group.

Da Conceicao MJ and Coelho L [16] found a significantly longer duration of motor block with bupivacaine as compared to ropivacaine, which corroborated with our results. Similarly, Omar Elsafty et al [10] reported shorter duration of motor block with ropivacaine than bupivacaine but no difference in the duration of analgesia. In other study, Locatelli et al [17] observed that ropivacaine is associated with lower incidence of residual motor blockade compared with bupivacaine. However, in contrast to our results, Tan JS et al [18] did not found significant difference in degree of motor blockade between ropivacaine and bupivacaine in paediatric caudal block.

With regards to haemodynamics, we did not found any significant difference in mean heart rate and arterial pressures between the two groups, which matched with the results obtained by Da Conceicao MJ and Coelho L [16].

All the caudal blocks were considered as clinically successful as none of the children required additional analgesic doses during surgery.

In conclusion, a caudal epidural block by 1 ml/kg, 0.2% ropivacaine or 1 ml/kg, 0.25% bupivacaine provides comparable intra-operative as well as postoperative analgesia when administered just after induction of GA in children undergoing infraumbilical surgery. However, 0.2% ropivacaine associated with less motor block compared to 0.25% bupivacaine. The lower intrinsic toxicity and lesser motor blockade with ropivacaine makes it a suitable agent for caudal epidural block in children.

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