

## Comparative study of caudal Ropivacaine with ropivacaine & Ketamine for postoperative analgesia in paediatric patients

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### Abstract

**Objective:** Objective of this study was to determine the efficacy of caudal Ketamine added to ropivacaine in providing postoperative analgesia in pediatric age group.

**Materials and Method:** This was a prospective randomized double blind study carried out in 60 ASA grades I/II children (2-9 years) posted for below umbilical surgeries over a period of 2 years. They were randomized into two groups of 30 each. Group A received caudal ropivacaine 0.25% (1ml/kg) & Group B received caudal ropivacaine 0.25% (1ml/kg) with Ketamine (0.5mg/kg). The parameters studied were intraoperative hemodynamic changes, duration of postoperative analgesia and incidence of complications.

**Result:** The mean duration of post-operative analgesia was significantly higher in Group B (395.26±55.97 minutes) than in group A (217.66±30.42 minutes),  $p = 0.000$ . The perioperative hemodynamic parameters were stable and comparable in both the groups. Incidence of vomiting in group A was 6.6 % and 10% in group B, the difference being statistically insignificant. None of the patients in both the groups had bradycardia, hypotension and delirium.

**Conclusion:** The present study demonstrated that caudal administration of ropivacaine 0.25% (1 ml/kg) with Ketamine (0.5 mg/kg) results in longer duration of analgesia compared with 0.25% ropivacaine (1 ml/kg) alone, without any significant side-effects.

**Keywords:** Caudal Analgesia, Ketamine, Ropivacaine

### Introduction

The concept of postoperative pain relief & its application in paediatric age group has improved dramatically over the recent years. Postoperative analgesia is equally important in children as in adults. Systemic narcotic analgesics produce respiratory depression, which is not desired in paediatric patients due to low oxygen reserve. Systemic non-narcotics may not be adequate for total pain relief. Regional techniques such as caudal epidural, lumbar epidural and peripheral nerve blocks offer a better option.<sup>(1)</sup>

In paediatric age group, caudal epidural technique is one of the most popular techniques as it is reliable, safe & easy to administer. It is commonly used for post-operative analgesia in below umbilical surgeries.<sup>(1)</sup> One of the limitations of single injection caudal block is its relatively shorter duration of post-operative analgesia.<sup>(2)</sup> Managing continuous caudal epidural catheter for providing extended analgesia is difficult in paediatric patients due to increased risk of catheter related infections. To overcome these problems, adjuvants can be added to the local anaesthetic solution.<sup>(3)</sup>

Adjuvants commonly used in caudal epidural technique are Ketamine,<sup>(3,4,5,6)</sup> Fentanyl<sup>(7,8)</sup> and clonidine.<sup>(2,9)</sup> Undesired effects of Fentanyl are respiratory depression, itching & vomiting<sup>7</sup> and that of Clonidine are bradycardia and respiratory depression.<sup>(9)</sup> Ketamine is inexpensive, readily available potent analgesic with minimal cardiorespiratory depressant effect.

Bupivacaine is routinely used local anaesthetic in caudal epidural anaesthesia. Ropivacaine is a local anaesthetic structurally similar to bupivacaine having lower incidence of cardiovascular side effects, neurotoxicity<sup>(2)</sup> and lesser degree motor blockade.<sup>(10)</sup>

In this study, we compared efficacy of caudal Ropivacaine with combination of Ropivacaine and Ketamine for post operative analgesia.

### Materials and Method

This study was conducted at Mahatma Gandhi Mission's Medical College Hospital, Aurangabad from July 2011 to August 2013 after approval from the institutional ethical committee. Written informed consent of the parents was obtained. Children belonging to ASA grade 1 & 2 between 2-9 years of age posted for elective below umbilical surgeries were included in this study. Children with local infection at the caudal region, bleeding diathesis, pre-existing neurological diseases and any congenital anomaly of the lower back were excluded. Patients were randomized into two groups – group A & group B, by sealed envelop method, each group containing 30 children. Solutions used for injection were Inj. Ropivacaine (0.25%) 1ml/kg in group A and Inj. Ropivacaine (0.25%) 1ml/kg with preservative free Inj. Ketamine 0.5mg/kg in group B. Time of injection ( $T_0$ ) was noted. The anaesthesiologist who prepared the solution was different from the one who gave caudal epidural &

observed the patient. Both patient & the observer were blinded to the study drug.

Child was kept nil per oral for 6 hours & sips of glucose water was advised two hours prior to surgery. Weight of the child, pre-operative parameters heart rate (HR), blood pressure (SBP & DBP), peripheral oxygen saturation (SpO<sub>2</sub>) were recorded.

Inj. Glycopyrrolate (4mcg/kg) IV and Inj. Midazolam (0.04mg/kg) IV was given as premedication. Hemodynamic parameters were recorded after premedication & these values were taken as baseline. Anaesthesia was induced with Oxygen (50%), Nitrous oxide (50%) & Sevoflurane 6-8%. patient was intubated with appropriate size ET tube, after giving Inj. Atracurium 0.5mg/kg IV. Patients were given lateral position. Under all aseptic precautions caudal block was performed using 22G short bevel hypodermic needle. Surgery was started 20 minutes after the caudal block. Intra operatively HR, MAP and SpO<sub>2</sub> were monitored every 5 minutes. Any increase in MAP or HR of more than 20% from baseline values at the time of surgical incision was adjudged as failure of caudal analgesia & rescue analgesia in the form of Inj. Fentanyl 1mcg/kg IV was administered. Ringer lactate was administered according to body weight & fasting status based on 4-2-1 formula. Anaesthesia was maintained with O<sub>2</sub> (50%) + N<sub>2</sub>O (50%) & sevoflurane 1-2%.

At the end of the surgery, all anaesthetic gases were turned off. Patient was reversed with Inj.

Neostigmine 0.04mg/kg & Inj. Glycopyrrolate 10mcg/kg and patient was extubated. HR, MAP, SpO<sub>2</sub> and pain score were recorded every 15 minutes in the Recovery room for 1 hour, every hour for 6 hours then at 8, 10, 12 and 24<sup>th</sup> Hr. in the ward. Postoperative pain score was assessed based on the 5 point behaviour of the child.<sup>(11)</sup> 1- Playing & laughing, 2- Happy, 3- Neutral, 4- Cries indicating pain, 5- Cries which cannot be distracted.

Patients who had a pain score of 4 & above were administered analgesics in the form of Paracetamol suppository 30mg/kg. The time of administration of first dose of Paracetamol (T<sub>p</sub>) was noted. Difference between T<sub>0</sub> and T<sub>p</sub> was taken as duration of analgesia. Side effects like vomiting, bradycardia, hypotension emergence delirium if present were noted.

**Statistical analysis:** The results of continuous variables were given as mean ± SD and proportion as percentage. The difference between the two groups was assessed by students – t test and chi-square test. For all the tests a ‘p’ value of 0.05 and less was considered for statistical significance.

## Results

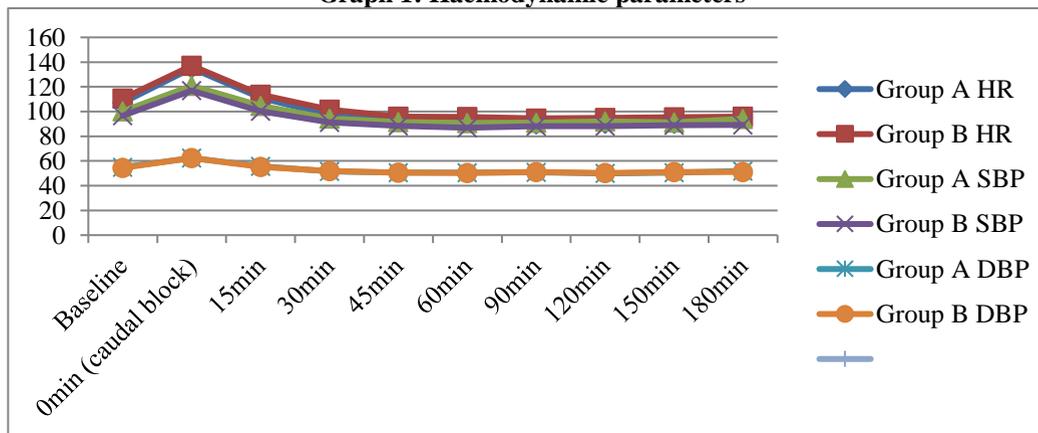
There were no statistically significant differences between the two groups with respect to age, gender, weight, duration of the surgery, baseline heart rate and blood pressure (Table 1).

**Table 1: Patient characteristics and clinical parameters**

Parameter	Group A	Group B	P value
Age (years)	5.16±2.60	4.73±1.93	P = 0.405 NS
Weight (Kg)	16.02 ± 4.31	16.06 ± 3.39	P = 0.972 NS
Gender – Male: Female	27 : 03	26 : 04	
Duration of surgery (minutes)	60.16 ± 17.76	63.10 ± 14.65	P = 0.134 NS
Baseline HR (per minute)	107.13 ± 15.76	110.67 ± 14.65	P = 0.37 NS
Baseline SBP (mm Hg)	100.20 ± 9.04	96.73 ± 8.8	P = 0.139 NS
Baseline DBP (mm Hg)	54.86 ± 5.85	54.46 ± 6.57	P = 0.802 NS

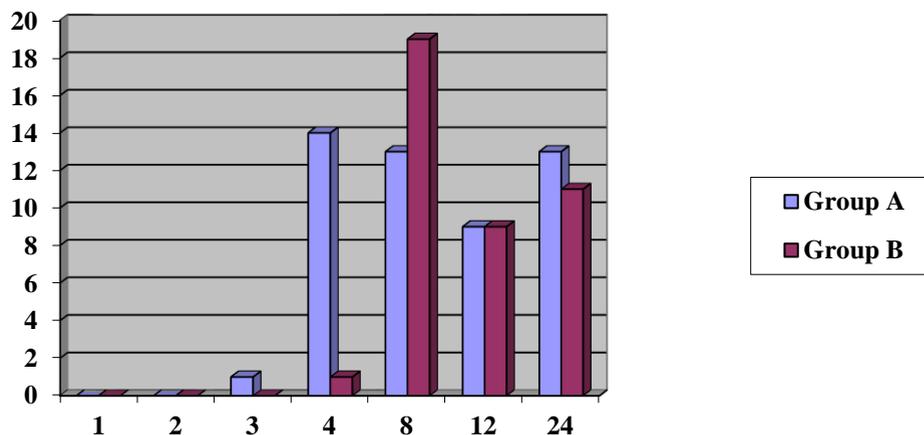
NS = Not significant

**Graph 1: Haemodynamic parameters**



All patients remained hemodynamically stable throughout the surgery with no statistically significant difference between the groups (Graph 1).

**Graph 2: Pain score at various time intervals**



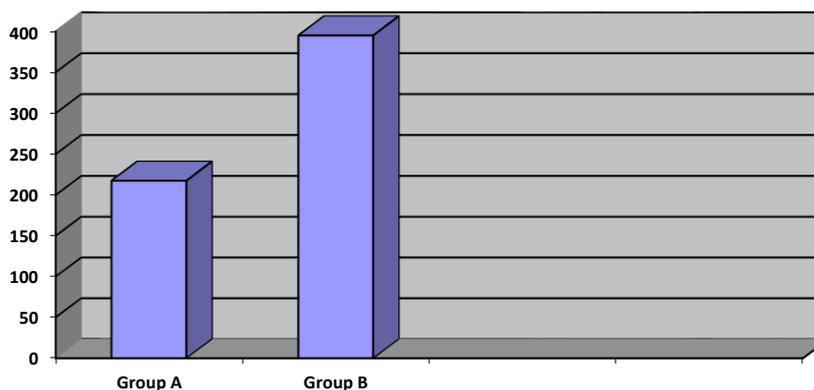
The number of patients in the two study groups showing pain score  $\geq 4$  at various time intervals are shown in graph 2. At the end of first and second hour none of the patients in both the groups required any analgesia.

At the end of third hour, 1(3%) patient in group A had a pain score of  $\geq 4$  whereas none of the patients had a score of  $\geq 4$  in group B, the difference being statistically insignificant ( $p > 0.05$ ).

At the end of fourth hour, 14(47%) patients in group A had a pain score of  $\geq 4$  and only 1(3%) in group B had a similar pain score. The difference was statistically highly significant ( $p < 0.01$ ). The pain score was  $\geq 4$  in 13(43%) of patients in group A and 19(63%) in group B by the end of eight hour which was not statistically significant.

At the end of 12th and 24th hour, group A had 9(30%) and 13(43%) patients with pain score of  $\geq 4$  and group B had 9(30%) and 11(33%) with similar pain score respectively. The differences were found statistically insignificant. The subjects with a pain score of  $\geq 4$  was significantly lower in group B compared to group A at the end of 3<sup>rd</sup> and 4<sup>th</sup> hour.

**Graph 3: Duration of analgesia**



The mean duration of analgesia was  $217.66 \pm 30.42$  min in group A with a range of 165-285 min. In group B, the mean duration of analgesia was  $395.26 \pm 55.97$  min with a range of 275 to 505 min. The difference in the mean duration of analgesia was statistically highly significant ( $p = 0.000$ ).

**Table 2: Incidence of Complications in Group A and Group B**

Complications	Group A		Group B	
	No.	%	No.	%
Vomiting	02	6.67%	03	10%
Bradycardia	00	NA	00	NA
Hypotension	00	NA	00	NA
Behavioural changes	00	NA	00	NA

The incidence of nausea and vomiting was among 6.67% in group A compared to 10% in group B. The difference was not statistically significant. None of the patients in both the groups had hypotension, Bradycardia or behavioural changes.

## Discussion

The past decade has witnessed many advances in the understanding and treatment of pain in children. Caudal epidural blockade is one of the most popular regional blocks used in paediatric anaesthesia. In the present study, there were no significant differences in the two groups with regard to age, weight and sex.

In our study we have used ropivacaine 0.25%, 1ml/kg. Elsafty O et al<sup>(10)</sup> in their study used 0.375% ropivacaine and 0.375% 1ml/kg bupivacaine to compare the motor recovery and reported that ropivacaine showed a significant lesser motor block than bupivacaine. Ray<sup>(12)</sup> et al compared caudal bupivacaine with ropivacaine 0.25% concentration and 0.75ml/kg. They concluded that caudal ropivacaine provides effective analgesia similar to bupivacaine with lesser motor blockade.

There are many studies where Ketamine was added as an additive to bupivacaine in caudal block. Nafiu<sup>(5)</sup> et al studied the effect of Ketamine 0.5mg/kg added to 0.125% bupivacaine and compared it to plain 0.125% bupivacaine. They concluded that adding Ketamine 0.5mg/kg to bupivacaine prolonged the duration of analgesia significantly. Odes<sup>(4)</sup> et al added similar dose of Ketamine (0.5mg/kg) to ropivacaine and had similar conclusion. Semple<sup>(13)</sup> et al worked on the optimum dose of Ketamine for caudal epidural blockade in children and concluded that optimal dose for Ketamine is 0.25-0.5mg/kg for caudal block. Considering above study, we used Ketamine 0.5mg/kg along with ropivacaine to prolong the duration of analgesia while avoiding the side effects like hallucinations associated with higher doses.

In our study, haemodynamic parameters i.e. systolic BP, Diastolic BP and HR were comparable in both the groups at all time intervals. We chose to give

premedication with Inj. Atropine as a routine protocol for paediatric patients undergoing general anaesthesia in our hospital. Readings after administration of premedication were taken as baseline values. Unlike our study, Odes<sup>(4)</sup> et al observed that decrease in systolic BP with plain ropivacaine was statistically significant when compared with caudal Ketamine alone and caudal Ketamine with ropivacaine.

We used objective pain scale to assess post operative analgesia. It has been used to equate pain and discomfort in young children with changes in standardized behavioral and physiologic parameters. It does not require patient participation. In our study, pain score was  $< 4$  at the end of 1<sup>st</sup> and 2<sup>nd</sup> hour in all the patients in both the groups. At the end of 3<sup>rd</sup> hour, 1(3%) of children in group A and none of the children in group B had a pain score of  $\geq 4$ . At the end of 4<sup>th</sup> hour, 14(46%) children in group A and only 1(3%) child in group B had pain score  $> 6$ , which was statistically highly significant ( $p < 0.01$ ). The difference was not significant between the 2 groups during the remaining time interval with regards to analgesic efficacy.

The duration of analgesia was significantly prolonged in ropivacaine-Ketamine group ( $395.26 \pm 55.97$  minutes) compared to ropivacaine group ( $217.66 \pm 30.42$  minutes) ( $p = 0.000$ ) in our study. This is in agreement with a study by Sabbar et al,<sup>(14)</sup> who found that addition of Ketamine to local anaesthetic prolongs the duration of analgesia after a single shot caudal block. They reported an increase in the mean duration of analgesia ( $11.4 \pm 2.8$  Hr) after the addition of Ketamine when compared to local anaesthetic alone ( $3.14 \pm 0.94$  hour).

Martindale et al,<sup>(3)</sup> in a study of children aged 3 months - 6 years undergoing Herniotomy and orchidopexy, found that the mean duration of post-operative analgesia was significantly increased on adding Ketamine 0.5 mg/kg to bupivacaine 0.25% (1 ml/kg) (10Hr) compared to bupivacaine alone (4.75 Hr). In this study patient received Paracetamol as premedication and received Diclofenac in the intraoperative period. This could be the reason for longer duration of analgesia when compared to our study. Nafiu et al<sup>(5)</sup> confirmed the superiority of caudal Ketamine with bupivacaine over caudal Ketamine and caudal bupivacaine groups in a double blind study of children, 2-8 years of age, undergoing lower abdominal surgery. The mean duration of analgesia was significantly longer in bupivacaine with Ketamine group (14 hours) compared with those receiving Ketamine and bupivacaine alone (8 and 4 hours respectively). In a study conducted by Odes<sup>(4)</sup> et al, they observed their mean duration of analgesia in ropivacaine group, Ketamine group, ropivacaine plus Ketamine group to be  $435.6 \pm 273$  min,  $852 \pm 309$  min and  $1032 \pm 270$  min respectively.

The duration of analgesia achieved by the addition of Ketamine to local anaesthetics (ropivacaine/bupivacaine) varies widely in these studies (5 – 16 hours). This may be the result of a number of factors: dose of Ketamine used; differences in premedication and volatile anaesthetics used; type of surgery; indications for rescue analgesia; assessment of pain and statistical analysis.

There was no incidence of bradycardia or hypotension in both the groups, in our study. Two of the children in group A and three of them in group B had an episode of vomiting which was treated with Inj. Ondansetron (0.15 mg/kg) IV. We observed that the addition of Ketamine to ropivacaine in our study did not result in an increase in the incidence of side effects. The main side-effects of epidurally administered Ketamine are behavioural changes which we did not observe in any of the patient.

### Conclusion

The present study demonstrated that caudal administration of ropivacaine 0.25% (1 ml/kg) with Ketamine (0.5 mg/kg) results in longer duration of analgesia compared with 0.25% ropivacaine (1 ml/kg) alone, without any significant side-effects.

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