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Original research article

A comparative study of dexmedetomidine with ropivacaine versus dexamethasone with ropivacaine for caudal block in children

[1]Dr. K Sriramamurthy, [2]Dr. Keerti, [3]Dr. Kiran K N, [4]Dr. P G Raghavendra
[1]Professor (Retired), Department of Anesthesia, MRMC Medical College, Kalaburagi, Karnataka, India
[2]Fellow IDCCM, Department of Critical Care Medicine, M S Ramaiah Medical College, Bangalore, Karnataka, India
[3]Associate Professor, Department of Anesthesia, RIMS, Raichur, Karnataka, India
[4]Assistant Professor, Department of Anesthesia, RIMS, Raichur, Karnataka, India

Corresponding Author:
Dr. P G Raghavendra

Abstract

Caudal block is commonly performed after induction of general Anaesthesia. Caudal analgesia intraoperatively reduces the amount of inhaled and intravenous anaesthetic administration, attenuates the stress response to surgery, facilitates a rapid, smooth recovery, and provide good immediate post-operative analgesia. But one of the major limitations of caudal block is relatively short duration of post-operative analgesia. Hence adjuvant drugs such as, Dexamethasone, Dexmedetomidine Ketamine, Clonidine, Opioids have been used to prolong caudal analgesia. 60 children posted for elective infraumbilical surgeries are randomly allocated according to computerized randomization chart into two groups: Group A (caudal 0.2% Ropivacaine + 0.1mg/kg Dexamethasone) and Group B (caudal 0.2% Ropivacaine + 2 µg/kg Dexmedetomidine). Study reveals that, there was no statistical significant difference of mean FLACC scores between the groups A and B at 0 hours, 2 hours (p>0.05). Whereas there was statistically very highly significant difference of mean FLACC scores between the groups A and B at 6 hours, 8 hours, 10 hours, 12 hours, 14 hours, 16 hours and 18 hours (P<0.001). There was highly significant difference of the mean FLACC score at 4 hours. There was statistical significant difference of mean FLACC scores between the groups A and B at 20 hours and 24 hours (p<0.05).
Keywords: Dexmedetomidine, ropivacaine, caudal block in children

Introduction

Control of postoperative pain is important in paediatric patients because poor pain control may result in increased morbidity and mortality [1].

Some of the most important barriers to pain control in paediatric patients are the myths that children's and infants do not feel pain, that pain is not remembered, and that there are no untoward consequences of experiencing pain. This may hinder the management of pediatric pain [2].

Caudal anaesthesia is the most popular and safe technique in children. It is typically combined with general anaesthesia for intraoperative supplementation and postoperative analgesia in children's undergoing infraumbilical surgeries.

Caudal block is commonly performed after induction of general anaesthesia. Caudal analgesia intraoperatively reduces the amount of inhaled and intravenous anaesthetic administration, attenuates the stress response to surgery, facilitates a rapid, smooth recovery, and provide good immediate post-operative analgesia [3].

But one of the major limitations of caudal block is relatively short duration of post-operative analgesia. Hence adjuvant drugs such as, Dexamethasone, Dexmedetomidine Ketamine, Clonidine, Opioids have been used to prolong caudal analgesia [4].

Ropivacaine, a long acting amide local anesthetic structurally related to bupivacaine has been utilized for paediatric caudal anaesthesia. Ropivacaine is used in the concentration of 0.1-0.5% for caudal anaesthesia. Ropivacaine is less lipophilic than bupivacaine hence less likely to penetrate large myelinated motor fibers, thus causing relatively lower degree of motor blockade. The diminished lipophilicity is additionally associated with decreased potential for CNS toxicity and cardio toxicity. The level and quality of the block are dependent upon dose, volume and concentration of the local anaesthetic

solution [5].
Dexamethasone, is most commonly used perioperatively to manage postoperative pain, nausea and vomiting thus ensuring overall better recovery. Recently several studies have shown that epidural administration of dexamethasone prolonged analgesia and reduced analgesic requirements in adults. When dexamethasone is used as an adjunct to local anaesthetics during brachial plexus block it effectively improved the quality of analgesia without side effects. Dexamethasone by its direct membrane stabilizing action on nerve produces local anaesthetic effect. Hence it potentiates the effect of ropivacaine and prolongs the duration of analgesia [6].
Dexmedetomidine compared to clonidine is a much more selective α_2 adrenoceptor responsible for its sedative and analgesic action without the unwanted vascular effects from activation of α_1 receptors. It also has opioid sparing effect. It produces arousable sedation with minimal respiratory effects in adults and children.
Addition of both Dexmedetomidine with ropivacaine administered caudally significantly increases the duration of analgesia. It also produces better quality of sleep and a prolonged duration of sedation.

Methodology
Study design: Comparative interventional study.
Source of data: The operation theatre complex, Post Anaesthesia Care Unit (PACU) and wards of Teaching and General Hospital.
Sample size: A total sample size of 60 patients is taken. 30 patients in each group.

Inclusion criteria
1. Children in the age group of 1-6 years.
2. Body weight <20kgs.
3. Belonging to ASA-I & II.
4. Posted for infraumbilical surgeries.
5. Surgery lasting for less than 2hrs.

Exclusion criteria
1. Posted for Laparoscopic surgeries.
2. ASA grading > II.
3. Contraindications to caudal anesthesia like:
a) Hypersensitivity to local anesthetics, steroid.
b) Bleeding diathesis.
c) Infections at caudal site.
d) Known congenital sacral bone abnormalities, spina bifida.
e) Preexisting neurological disease.
f) History of developmental delay, mental retardation, type-1 diabetes.

Informed consent: For all the children fulfilling the selection criteria, before enrollment, an informed written parental consent is obtained after explaining the nature of the study.

Methods
60 children posted for elective infra-umbilical surgeries are randomly allocated according to computerized randomization chart into two groups: Group A (caudal 0.2% Ropivacaine + 0.1mg/kg Dexamethasone) and Group B (caudal 0.2% Ropivacaine + 2 µg/kg Dexmedetomidine).

Results

Table 1: Distribution of patients according to duration analgesia

Duration of analgesia in hours	Group A (Dexamethasone with Ropivacaine)		Group B (Dexmedetomidine with Ropivacaine)	
	No.	%	No.	%
≤ 24 hours	27	90.0	23	83.3
> 24 hours	3	10.0	9	16.7
Total	30	100.0	30	100.0
Mean ± SD	17.67 ± 3.40		21.83 ± 3.87	
t -test value P-value	t = 2.371 P = 0.031 S			

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

The mean duration of analgesia in hours in the group A was 17.67 ± 3.40 and the mean duration of analgesia in hours in the group B was 21.83 ± 3.87.
There was statistical significant difference of mean duration analgesia between the groups A and B (p<0.05). The mean duration of analgesia was significantly less in Groups A (DEXAMETHASONE

WITH ROPIVACAINE) as compare to Group B (DEXMEDETOMIDINE WITH ROPIVACAINE).

Table 2: Side effect wise distribution of patients

Variable	Group A (Dexamethasone with Ropivacaine)		Group B (Dexmedetomidine with Ropivacaine)	
	No.	%	No.	%
No side effects	30	90.0	29	3.3
Side effects	0	0.0	1	96.7
Total	30	100.0	30	100.0
X2-test value P-value	X2yates = 1.012		P = 0.917	NS

NS=not significant, S=significant, HS=highly significant, VHS=very highly significant Present study observed that, 1 (3.3%) patient had side effects in the group B but there were no side effect patients in group A.
There was no statistical significant difference of side effects analgesia between the group A and B (P>0.05)

Table 3: Comparison of FLACC scores of patients between the groups

Time period	Group A	Group B	t –test value	P-Value & Significance
	Mean ± SD	Mean ± SD		
0 hours	0 ± 0	0 ± 0	t = 0.0	P= 1.000, NS
2 hours	0 ± 0	0 ± 0	t = 0.0	P= 1.000, NS
4 hours	0.27 ± 0.44	0 ± 0	t = 3.247	P= 0.002, HS
6 hours	0.96 ± 0.25	0 ± 0	t = 16.55	P= 0.000, VHS
8 hours	1.53 ± 0.50	0.72 ± 0.46	t = 6.625	P= 0.000, VHS
10 hours	2.23 ± 0.65	1.00 ± 0.0	t = 9.893	P= 0.000, VHS
12 hours	2.80 ±0.70	1.32 ± 0.46	t = 9.632	P= 0.000, VHS
14 hours	3.83 ± 0.96	1.91 ± 0.40	t = 9.723	P= 0.000, VHS
16 hours	4.40 ± 1.44	2.37 ± 0.48	t = 7.821	P= 0.000, VHS
18 hours	4.56 ± 1.07	2.97 ± 0.66	t = 5.281	P= 0.000, VHS
20 hours	3.61 ± 1.00	2.96 ± 0.98	t = 2.861	P= 0.948, S
24 hours	3.75 ± 1.02	4.30 ± 1.09	t = 2.395	P= 0.106, S

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant Study reveals that, there was no statistical significant difference of mean FLACC scores between the groups A and B at 0 hours, 2 hours (p>0.05).

Whereas there was statistically very highly significant difference of mean FLACC scores between the groups A and B at 6 hours, 8 hours, 10 hours, 12 hours, 14 hours, 16 hours and 18 hours (P<0.001). There was highly significant difference of the mean FLACC score at 4 hours. There was statistical significant difference of mean FLACC scores between the groups A and B at 20 hours and 24 hours (P<0.05).
The mean FLACC scores were significantly more in group A (DEXAMETHASONE WITH ROPIVACAINE) as compare to group B (DEXMEDETOMIDINE WITH ROPIVACAINE) at 4 hours, 6 hours, 8 hours, 10 hours, 12 hours, 14 hours, 16 hours and 18 hours, 20 hours and 24 hours.

Table 4: Comparison of rescue of analgesia between the groups A and B

Variable	Group A	Group B	t-test value	P- Value & Significance
	Mean ± SD	Mean ± SD		
Rescue of analgesia	1.43 ± 0.67	0.71 ± 0.61	t = 4.532	P = 0.000, VHS

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

Study reveals that, there was statistically very highly significant difference of average of rescue analgesia between Group A (DEXAMETHASONE WITH ROPIVACAINE) and Group B (DEXMEDETOMIDINE WITH ROPIVACAINE). The average of rescue analgesia was significantly high in Group A as compare to Group B.

Table 5: Comparison of rescue of analgesia between the groups A and B

Time period	Group A	Group B	X2 yates-test value	P-Value & Significance
	Number (%)	Number (%)		
0 hours	0 (0.0%)	0 (0.0%)	X2 = 0.0	P= 1.00, NS
2 hours	0 (0.0%)	0 (0.0%)	X2 = 0.0	P= 1.00, NS
4 hours	0 (0.0%)	0 (0.0%)	X2 = 0.0	P= 1.00 NS
6 hours	0 (0.0%)	0 (0.0%)	X2 = 0.0	P= 1.00, NS
8 hours	0 (0.0%)	0 (0.0%)	X2 = 0.0	P= 1.00, NS
10 hours	0 (0.0%)	0 (0.0%)	X2 = 0.0	P= 1.00 NS
12 hours	0 (0.0%)	0 (0.0%)	X2 = 0.0	P= 1.00, NS
14 hours	6 (20.0%)	0 (0.0%)	X2 = 4.43	P= 0.035, S
16 hours	14 (46.7%)	0 (0.0%)	X2 = 15.13	P= 0.000 VHS
18 hours	5 (16.7%)	2 (6.7%)	X2 = 0.041	P= 0.921, NS

20 hours	3 (6.7%)	14 (46.7%)	X2 = 9.86	P= 0.001, VHS
24 hours	15 (50.0%)	4 (13.3%)	X2 = 12.00	P= 0.000 VHS

NS=not significant, S=significant, HS=highly significant, VHS=very highly significant Study reveals that, there was no statistical significant difference of rescue of analgesia between the groups A and B at 0 hours, 2 hours, 4 hours, 6 hours, 8 hours, 10 hours, 12 hours and 18 hours (p>0.05). Whereas there was statistical significant difference of rescue analgesia between the groups A and B at 14 hours and statistically very highly significant at 16hours, 20 hours and 24 hours (P<0.001).

Discussion

The results of our study demonstrated that caudal administration of both Dexamethasone and Dexmedetomidine added to Ropivacaine prolonged the duration of analgesia in children undergoing infraumbilical surgeries. There was reduced rescue analgesia requirement during 24hrs in both the groups and time for rescue analgesia was marginally prolonged in group receiving caudal Dexmedetomidine.

P Krishna Prasad and Snehalatha Bhashyam, B Sowbhagya Lakshmi *et al*. did a study to compare Dexamethasone versus Dexmedetomidine as adjuvant to Ropivacaine 0.2% in Caudal Analgesia in Pediatric Infraumbilical Surgeries [7]. 60 eligible children's belonging to ASA status I and II of either sex were randomly selected and divided into two equal groups. Group A (n = 30) received caudal 0.2% Ropivacaine (1 ml/kg) + Dexamethasone (0.1 mg/kg) making the volume to 1 ml and Group B (n = 30) received caudal 0.2% Ropivacaine (1 ml/kg) + Dexmedetomidine (2 µg/kg) making the volume to 1 ml. There was no significant difference in the hemodynamic parameters between the two groups in intraoperative and postoperative periods. This finding is consistent with Our study (P<0.001).

This study showed no significant difference between the two groups as regard to the incidence of side effects like our study.

In Group A, the FLACC and MOPS score reached 4 at 6th hr in most of the patients with mean analgesic duration of 478.04 ± 61.22 min (8.9 h). In Group B, the FLACC and MOPS score reached 4 at 12 hr in most of the patients with mean analgesic duration of 724.81 ± 36.30 min (12.68 h). Rescue analgesia was administered when MOPS and FLACC ≥4.

However, In our study in group A FLACC score reached ≥4 at 16 hrs in most of patients and mean analgesic duration was 17.67 ± 3.40 hrs and in group B FLACC score reached ≥4 at 24hrs in most of the patients with mean duration of analgesia in group B was 21.83 ± 3.87 hrs. Rescue analgesia was given when FLACC score >4.

Because in this study both FLACC score and MOPS score was used for pain assessment but in our study only FLACC score was used. Also, there was differences with respect to the Age group, type and duration of surgery when compared to our study.

This study concluded that Dexmedetomidine is better than Dexamethasone as an adjuvant to Ropivacaine in single-shot caudal anesthesia for paediatric infraumbilical surgeries with significant postoperative analgesia providing a better quality of sleep and a prolonged duration of arousable sedation without any significant side effects. The results are consistent with our study which showed a statistically significant prolonged duration of analgesia with the use of Dexmedetomidine.

Prospective randomized comparative study between Dexmedetomidine (1µg/Kg) And Dexamethasone (0.1mg/Kg) as adjuvants to 0.25% Bupivacaine in caudal analgesia in Paediatric patients undergoing lower abdominal surgeries was done by Dr. Bhavani Gonapa and Dr. Shaik Vahida [6]. This study was done in 100 patients of both the sex, aged between 1-5 years. This cohort was divided into two groups, Group 1 patients received 0.25% Bupivacaine in a dose of 0.5ml/kg with Dexamethasone 0.1mg/kg. Group 2 patients received 0.25% Bupivacaine in a dose of 0.5ml/kg with caudal Dexmedetomidine 1µg/kg.

This study showed that In Dexmedetomidine group, 82% patients required single rescue analgesic and 18% required two rescue analgesics. This is in agreement with our study which showed that the average of rescue analgesia was significantly high in Group A (1.43 ± 0.67) as compared to Group B (0.71 ± 0.61) and P value=0.000 (VHS). This study concluded that Dexmedetomidine(1µg/kg) marginally prolonged the duration of analgesia when compared to Dexamethasone used as adjuvant to Bupivacaine. This is in line with our study which showed a lower postoperative pain scores with use of Dexmedetomidine.

The mean duration of analgesia in group 1 was 449.48±5.98 min and in group 2 was 484.94±2.85 min respectively. However, in our study the mean duration of analgesia in group A and group B was 17.67 ± 3.40 hrs and 21.83±3.87 hrs (Mean ± SD) respectively.

This is because in this study Dexmedetomidine 1µg/kg was used but in our study patients received dosage of 2µg/kg. Also, in this study Modified Objective pain score was used for postoperative pain assessment but in our study FLACC score was used. And there was differences with regard to the type and duration of surgery.

A comparative study was done by Elham M. El-Feky, Ahmed A. Abd El Aziz regarding use of Fentanyl, dexmedetomidine, dexamethasone as adjuvant to local anesthetics in caudal analgesia in pediatrics [8]. This study included 120 children's aged 3-10 yrs scheduled for lower abdominal surgeries. This cohort was divided into four groups. Group I (control), in this group they received 0.5 ml of equal mixture of

Bupivacaine 0.25% and Lidocaine 1% diluted in saline (in a dose of 0.5 ml/kg) caudally. In Group II (Fentanyl group), they received the same mixture of Group I + Fentanyl (1µg/kg) caudally. In Group III (Dexmedetomidine group), the patients received the same mixture of Group I + Dexmedetomidine (1µg/kg) caudally. While in Group IV (Dexamethasone group), the patients received the same mixture of Group I + Dexamethasone (0.1 mg/kg) caudally.

The number of patients who needed rescue analgesia and postoperative pain scores in the first 6 hrs was significantly decreased in both Dexmedetomidine and Dexamethasone groups in comparision to other two groups. This finding is consistent with our study in which both Dexmedetomidine and Dexamethasone prolonged analgesic duration of Ropivacaine.

The incidence of postoperative adverse effects like respiratory depression, vomiting and itching was increased significantly in the Fentanyl group compared to other groups. The other adverse effects like hypotension and bradycardia was insignificant when compared among study groups. This in in agreement with our study in which the incidence of side-effects was statistically insignificant when compared between the two groups.

The mean analgesic duration in Group III and Group IV was 490.4 ± 13.6 min and 498.2 ± 15.4 min respectively. However, our study showed that the mean analgesic duration in group A and group B was 17.67 ± 3.40 hrs and 21.83±3.87 hrs respectively.

This difference could be attributed due to, patients of 3 to 10 years age group included in this study but in our study, patients belonging to 1 to 6yrs age group were included. Our study used FLACC score for assessing pain postoperatively but in this study MOPS score was used. Also, the inability of the childrens to express their pain completely might have resulted in recording varying post-operative analgesia.

Conclusion

- The mean FLACC scores were significantly more in group A (DEXAMETHASONE WITH ROPIVACAINE) as compare to group B (DEXMEDETOMIDINE WITH ROPIVACAINE) at 4 hours, 6 hours, 8 hours, 10 hours, 12 hours, 14 hours, 16 hours and 18 hours, 20 hours and 24 hours.
- There was no statistical significant difference of rescue of analgesia between the groups A and B at 0 hours, 2 hours, 4 hours, 6 hours, 8 hours, 10 hours, 12 hours and 18 hours ($p>0.05$). Whereas there was statistical significant difference of rescue analgesia between the groups A and B at 14 hours and statistically very highly significant at 16 hours, 20 hours and 24 hours ($P<0.001$).

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