Original Article

Evaluation of Analgesic Efficacy of Caudal Dexamethasone Combined with Ropivacaine in Children Undergoing Lower Abdominal Surgeries: A Prospective, Randomized, Double Blind Control Study

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Abstract

Introduction: Various adjuvants such as opioids or α_2 agonists are being used to improve the quality and duration of caudal analgesia with local anaesthetics. We evaluated the effect of adding the dexamethasone to ropivacaine for paediatric caudal block.

Materials and Methods: 50 patients of age 1-5 years scheduled for various lower abdominal surgeries were divided into two equal groups in a randomized, double blind study. Group C (*n* = 25) received 1 ml/kg of 0.15% ropivacaine and Group D (*n* = 25) received 1 ml/kg of 0.15% ropivacaine in which 0.1 mg/kg dexamethasone was mixed for caudal analgesia. Postoperative pain scores, rescue analgesic consumption and side effects were evaluated up to 48 h after operation.

Results: Postoperative pain scores at 6 and 24 h postsurgery were significantly lower in Group D than in Group C. The number of children who are pain-free up to 48 h after surgery were greater in Group D than in Group C. Time to first rescue analgesic administration after surgery was also significantly longer in Group D than Group C.

Conclusion: The addition of dexamethasone 0.1 mg/kg to ropivacaine for caudal block significantly improves analgesic efficacy in children undergoing lower abdominal surgeries.

Keywords: Caudal analgesia, Paediatrics, Postoperative analgesia, Regional analgesia

INTRODUCTION

Various regional anaesthetic techniques have gained popularity for post-operative analgesia because in addition of providing adequate post-operative analgesia, they also reduce the requirement of general anaesthetics intraoperatively without significant side effects.[1-2] Caudal block is one of the most popular regional analgesic technique used now days in paediatric lower abdominal surgeries. To increase the efficacy of caudal analgesia with local anaesthetics, various adjuncts have been added such as opioids, neostigmine and α_2 agonists.[3-5] There are some adverse effects associated with the use of caudal opioids like nausea, vomiting, pruritis, urinary retention and respiratory depression.[3-5] Likewise, epidural administration of α_2 agonists produces hypotension, bradycardia and sedation.[3-6] Because of these side effects such adjuncts may not be appropriate for paediatric surgeries.

Ropivacaine is structurally related to bupivacaine. Compared to racemic bupivacaine, ropivacaine has lower centralnervoussystem toxicity and cardiotoxicity,[7-9] and it is better tolerated than bupivacaine.[10-11] Due to this reason ropivacaine is preferred than bupivacaine.

Dexamethasone has powerful anti-inflammatory as well as analgesic properties. Perineural injection of steroids is reported to influence post-operative analgesia.[12-15] With this background, this study was carried out to evaluate the efficacy of dexamethasone as an adjuvant to ropivacaine in caudal block.

MATERIALS AND METHODS

After ethical committee approval and informed consent from parents, this randomized double blind study was conducted in Govt. General Hospital, Kakinada between January 2014 and July 2014. 50 children of ASA Grade I and II, aged between 1 and 5 years undergoing lower abdominal surgeries were undertaken for the study. They were allocated into two groups by computer generated randomization table.

Group C: Received 1 ml/kg of 0.15% ropivacine and normal saline (maximum volume of 20 ml).

Group D: Received 1 ml/kg of 0.15% ropivacine plus dexamethasone (0.1 mg/kg) maximum volume of 20 ml.

Exclusion Criteria

Included a history of developmental delay or mental retardation Type I diabetes, known or suspected coagulopathy, known allergy to any local anaethetics or steroids, known congenital anamoly of the spine, or signs of spinal anomaly or infection at the sacral region.

All the patients are premedicated with syrup promethazine 0.1 mg/kg body weight on the previous night of surgery and induced with sevoflurane and 50% N_2O in oxygen via face mask. Intravenous (IV) cannulation was done using 22 G cannula, then injection atropine 0.02 mg/kg, injection. Ondasetron 0.1 mg/kg and injection midazolam 0.1 mg/kg was given IV as premedication. After discontinuing sevoflurane and N_2O, patients were induced with injection thiopentone 5 mg/kg and intubation aided by administering injection succinyl choline 2 mg/kg. Endotracheal (ET) intubation was done with appropriate size ET tube, position confirmed, and ET tube secured in place, standard caudal block was given in right lateral position by using 22G needle under aseptic conditions. Syringe containing equal volumes of either 0.15% ropivacine with normal saline or 0.15% ropivacine with dexamethasone were prepared and given to an investigator who was blinded to the identity of drugs and caudal block was given. Group C received 1 ml/kg of 0.15% ropivacine. and Group D received 1 ml/kg of 0.15% ropivacine and 0.1 mg/kg of dexamethasone. Surgery was conducted with O_2 + N_2O + sevoflurane 1% + vercuronium bromide.

Intra operative heart rate, pulse oximetry saturation (SPO_2), mean arterial pressure and end tidal CO_2 (ET CO_2) were monitored. After reversal of non-depolarizing muscle relaxants and after recovery from general anaesthesia, the patients were shifted to post anaesthesia care unit and vitals and pain was assessed by using the Children's Hospital of Eastern Ontaria Pain Scale (CHEOPS 0-10) (Table 1).

And the Faces Leg Activity Cry Consolability tool (FLACC, 0-10) (Table 2) at 30 min and 1, 2, and 3 h after operation. A child with a score of more than four on both CHEOPS and FLACC received 0.5 μg/kg of fentanyl IV for rescue analgesia.

Motor function was assessed using the following scale.

0 No motor block
1 Able to move legs
2 Unable to move legs.

The presence of other adverse events like bradycardia, respiratory depression, retching, vomiting or urinary retention were evaluated. Children were shifted from the PACU to the ward when the child was conscious, haemodynamically stable, absence of retching, vomiting and other side effects. In the ward pain was assessed by parents who were also blinded to the group assignment. The investigator who was blinded to group allocation and provided post-operative care, educated the parents on how to rate pain according to verbal and non verbal expressions of pain and behavioral changes on a numeric rating scale (NRS) from 0 to 10, with 0 representing "no pain" and 10 representing "the worst pain possible." The parents were instructed to asses pain at least once an hour.

Table 1: CHEOPS score

Parameter	Finding	Points
Cry	No cry	1
	Moaning	2
	Crying	2
	Screaming	3
Facial	Smiling	0
	Composed	1
	Grimace	2
Child verbal	Positive	0
	None	1
	Complaints other than pain	1
	Pain complaints	2
	Both pain and non pain complaints	2
Torso	Neutral	1
	Shifting	2
	Tense	2
	Shivering	2
	Upright	2
	Restrained	2
Touch	Not touching	1
	Reach	2

CHEOPS: Children's Hospital of Eastern Ontaria Pain Scale

Table 2: FLACC behavioral pain assessment

Categories	Scoring		
	0	1	2
Face	No particular expression or smile	Occassional grimace or grown, with drawn, disinterested	Frequent to constant quivering chin, 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: occasional complaint	Crying steadily, screams of sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching hugging or being talked to, distractible	Difficulty to console or comfort

FLACC: Faces leg activity cry consolability

Children received rescue analgesia for pain scores of 4 or greater on NRS.

Statistical Analysis

Comparisons between the groups were performed with Student's *t*-test, χ^2 tests and Fisher's exact test when appropriate. A *P* value of < 0.05 was considered significant. All statistical analysis was performed using Graph pad software (Graphpad prism 6.0 automated version).

RESULTS

The two groups were comparable in age, sex and weight (Table 3).

In PACU, FLACC scores were comparable between the groups. CHEOPS scores at 1, 2 and 3 h after surgery were higher in Group C than Group D with statistical significance (Table 4). The difference in CHEOPS scores between the groups was <1 point.

There were no cases of motor block after surgery and vomiting was observed in only one subject from Group C in PACU. There were no other adverse effects noted. The time to micturation (174 ± 77 min in Group C and 156 ± 43 in Group D ($P = 0.224$) which is statically not significant.

Pain scores determined by parents during the 48 h post-operative period is shown by NRS. Group D had significantly lower NRS scores than Group C, except 48 h. The number of subjects who were pain free during 48 h post-operative period was significantly greater in Group D (16 out of 23-70%) than in Group C (11 out of 23-48%). Rescue analgesic received during the post-operative 48 h is shown in Table 5 and Figure 1.

The analgesic duration of Group D was significantly longer than that of Group C ($P = 0.014$). The number of subjects who had rescue analgesic during the post-operative 48 h was significantly less in Group D (9 in 23) than in Group C

Table 3: Demographic data

	Group C	Group D	Total	Mean	SD
Age					
1-2	6	5	25	6.24	1.25
2-3	5	7			
3-4	8	8	25	6.24	1.50
4-5	6	5			
Sex					
Male	14	12	26	13.5	0.70
Female	11	13	24	11.5	0.70
Weight in kg					
Range	5-7 kg			6	1.14
	4-8 kg			6	2.28

SD: Standard deviation

Table 4: CHEOPS & FLACC score

	Group C (*n*=23)	Group D (*n*=23)	*P* value
CHEOPS			
30 min after surgery	2.3 (0.9)	2.2 (0.8)	0.554
1 h	2.4 (1.1)	2.0 (1.0)	0.049
2 h	2.1 (1.1)	1.3 (1.0)	0.002
3 h	1.6 (1.0)	1.1 (1.0)	0.023
FLACC			
30 min after surgery	0.9 (1.6)	0.5 (1.3)	0.313
1 h	1.2 (1.2)	0.7 (1.4)	0.175
2 h	0.8 (1.5)	0.3 (0.8)	0.057
3 h	0.3 (0.8)	0.0 (0.2)	0.066

CHEOPS: Children's Hospital of Eastern Ontaria Pain Scale, FLACC: Faces Leg Activity Cry Consolability

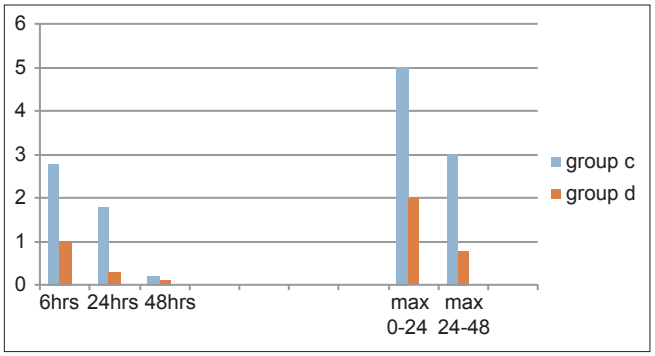

Figure 1: Pain scores during 48 h post-operative period. Max 0-24, maximal numeric rating scale (NRS) score during post-operative 0-24 h. Max 24-48, maximal NRS score during post-operative 24-48 h. *P* < 0.005

Table 5: Consumption of oral analgesics at post-operative 48 h data are shown as number of subjects (proportion, %)

	Group C (*n*=23) (%)	Group D (*n*=23) (%)	*P* value
Number of subjects who had rescue analgesic	15 (54)	7 (28)	0.027
Number of subjects who are pain free for post-operative 48 h	0 h 4 (46) 1 h 3 (29) 2 h 1 (8) 3 h 1 (8) >4 h 1 (8)	11 (71) 4 (26) 1 (2.6) 0 (0) 0 (0)	0.013

(15 in 23). Only few adverse effects are noted after hospital discharge with no significant differences between the two groups. Post-operative wound dehiscence was seen in one case from each group. One subject experienced vomiting in Group C, with no cases of vomiting in Group D after discharge.

DISCUSSION

This study demonstrates that the addition of dexamethasone increases the analgesic duration of caudal block with ropivacane. Also, severity of pain and analgesic consumption decreases by post-operative 48 h. Among the children who received dexamethasone in the caudal block, half experienced no pain and 71% required no oral analgesic during the 48 h post-operative period compared with children who did not receive dexamethasone. After lower abdominal surgeries, children without caudal block reported clinically significant pain and about 90% of the needed analgesia and about 70% required more than one type of analgesic.

Caudal block using ropivacaine alone reduces pain and analgesic consumption and 46% of subjects in Group C with ropivacaine alone needed no analgesic which correlated with the findings of previous study of Hong *et al.*[16] Based on this study we selected the former constitution and dose of ropivacaine for caudal analgesia. Analgesic duration of ropivacaine is 4-6 h.[17] Caudal block with ropivacaine alone provides sufficient analgesia for the immediate post-operative period, and so additional analgesia is not required. In the immediate post-operative period two types of pain scales are used for assessment of pain and the differences in pain scores were not significant between the groups for post-operative 3 h. Clinically relevant differences in pain scores and analgesic consumption between the groups occurred after 6 h after surgery. Adding dexamethasone significantly increases the analgesic duration of caudal block with ropivacane and reduces pain scores and analgesic consumption for post-operative 48 h.

Dexamethasone is commonly used in the perioperative period to reduce post-operative nausea and vomiting and also reported to have an analgesic effect.[18] The precise mechanism of analgesic effect of epidural or perineural dexamethasone is not clearly understood. Dexamethasone might have a local anaesthetic effect on nerve by direct membrane action.[19] Therefore, dexamethasone might potentiate the effect of ropivacaine and prolong the duration of analgesia. Another possible mechanism involves the effect of dexamethasone on the spinal cord. The transcription factor nuclear factor-kB (Nf-kB) is present throughout the nervous system and plays an important role in the development of pathological pain.[20] Dexamethasone regulates Nf-kB and prevent central sensitization after surgery and strengthens analgesia of caudal block. In our study children in Group D were without pain during the post-operative 48 h period compared with Group C and that could be due to prevention of hyperalgesia at the spinal cord level.

CONCLUSION

In conclusion, the addition of 0.1 mg/kg dexamethasone to ropivacaine for caudal block could significantly improve analgesic efficacy in children undergoing lower abdominal surgeries.

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How to cite this article: Sree MS, Laxshmi BS, Prasad PK, Bharathi A. Evaluation of Analgesic Efficacy of Caudal Dexamethasone Combined with Ropivacaine in Children Undergoing Lower Abdominal Surgeries: A Prospective, Randomized, Double Blind Control Study. Int J Sci Stud 2014;2(7):72-76.

Source of Support: Nil, **Conflict of Interest:** None declared.