Original Article

Evaluation of caudal dexamethasone with ropivacaine for post-operative analgesia in paediatric herniotomies: A randomised controlled study

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ABSTRACT

Background and Aims: Caudal analgesia is one of the most popular regional blocks in paediatric patients undergoing infra-umbilical surgeries but with the drawback of short duration of action after single shot local anaesthetic injection. We evaluated whether caudal dexamethasone 0.1 mg/kg as an adjuvant to the ropivacaine improved analgesic efficacy after paediatric herniotomies. **Methods:** Totally 128 patients of 1–5 years age group, American Society of Anaesthesiologists physical status I and II undergoing elective inguinal herniotomy were randomly allocated to two groups in double-blind manner. Group A received 1 ml/kg of 0.2% ropivacaine caudally and Group B received 1 ml/kg of 0.2% ropivacaine, in which 0.1 mg/kg dexamethasone was added for caudal analgesia. Post operative pain by faces, legs, activity, cry and consolability tool score, rescue analgesic requirement and adverse effects were noted for 24 h. **Results:** Results were statistically analysed using Student's *t*-test. Pain scores measured at 1, 2, 4, and 6 h post-operative, were lower in Group B as compared to Group A. Mean duration of analgesia in Group A was 248.4 ± 54.1 min and in Group B was 478.046 ± 104.57 min with $P = 0.001$. Rescue analgesic requirement was more in Group A as compared to Group B. Adverse effects after surgery were comparable between the two groups. **Conclusion:** Caudal dexamethasone added to ropivacaine is a good alternative to prolong post-operative analgesia with less pain score compared to caudal ropivacaine alone.

Key words: Caudal block, dexamethasone, paediatric herniotomy, ropivacaine

INTRODUCTION

Caudal block is the most popular and commonly used regional anaesthetic technique in children with a high success rate, for surgeries below the level of the umbilicus.[1] It reduces the requirement of inhaled and intravenous (IV) anaesthetic agents, attenuates the stress response to surgery, facilitates a rapid and smooth recovery and provides satisfactory post-operative analgesia[2] but with the limitation of relatively short duration of analgesia with single shot technique.[3] Use of caudal catheter for continuous infusion is usually not preferred due to high risk of catheter contamination from faecal soiling. To overcome this limitation, several adjuvants are added to local anaesthetic agent in a single shot technique. Opioids, alpha 2 agonists and ketamine have been studied with local anaesthetics to increase the efficacy of caudal analgesia but are associated with adverse effects such as nausea, vomiting, pruritus, urinary retention and respiratory depression (in case of caudal opioids), hypotension, bradycardia (with caudal alpha

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2 agonists) and more sedation with ketamine.[4-7] Among local anaesthetics, ropivacaine provides a greater margin of safety, less motor blockade, less neurological and cardiac toxicity and similar duration of analgesia in comparison to bupivacaine.[8] Corticosteroids have a strong anti-inflammatory action[9] and have been used via epidural, intrathecal, caudal and perineural routes in adults for prolonging post-operative analgesia.

This prospective double-blind study was designed to investigate whether dexamethasone as an adjuvant to 0.2% ropivacaine enhances the analgesic potency in paediatric herniotomies performed under caudal block,.

METHODS

This randomised controlled double-blind interventional study was initiated with due permission from the Institutional Ethical Committee. A written informed parental consent, of 128 patients of 1–5 years age group, belonging to American Society of Anaesthesiologists (ASA) physical status I and II undergoing elective inguinal herniotomy was taken. Patients having bleeding/coagulation disorder, local infection, sepsis, bacteraemia, vertebral deformity, pre-existing neurological diseases, allergy to ropivacaine or any other drug to be used were excluded from this study.

All parents were explained the about the anaesthetic technique and perioperative course during a pre-operative visit on the day before surgery. Patients were randomly allocated to two groups (64 patients in each group), and randomisation was done by pulling chits out of a partially sealed box. Blinding was done by preparation of the medication according to assigned group by one investigator and block was performed by the second investigator who was blinded to group assignment. The observation and data collection were done by the second investigator. Group 'A' received a bolus of 1 ml/kg of 0.2% ropivacaine with 1 ml saline. Group 'B' received a bolus of 1 ml/kg of 0.2% ropivacaine with dexamethasone 0.1 mg/kg in saline to make a total volume 1 ml.

On receiving the patient in the operation theatre, monitoring was attached in the form of electrocardiogram (ECG), pulse oximetric oxygen saturation (SpO_2), non-invasive blood pressure (NIBP) and parameters recorded. Pre-medication was done with injection glycopyrrolate 0.008 mg/kg and injection midazolam 0.05 mg/kg through already secured venous access. Anaesthesia was induced with injection ketamine 2 mg/kg and as a protocol of our hospital, thereafter caudal block was performed with 5 cm short bevelled 22-gauge needle in lateral decubitus position taking aseptic precautions. Once the needle was in epidural space, study drug was injected slowly, according to the group assigned in the chit after negative aspiration for blood and cerebrospinal fluid. Time of administration of block was noted. Anaesthesia was maintained with halothane and oxygen 40% and N_2O 60% with patient breathing spontaneously via Jackson Rees breathing circuit as the procedure was of short duration.

All patients were monitored by a standard protocol in a uniform pattern during anaesthesia and surgery. Continuous monitoring of vital parameters- heart rate, ECG, respiratory rate, NIBP, SpO_2 were done, and values were recorded before and after pre-medication, induction, caudal block, after incision and thereafter every 10 min until the surgery was over.

At the end of surgery, all anaesthetics were discontinued. Total time of surgery was recorded. Any side effects such as breath holding/apnoea, hypotension, involuntary movements, and nausea/vomiting were also noted.

After surgery patients were shifted to the post-anaesthesia care unit for further observation and monitoring. Patients post-operative pain status and degree of sedation were evaluated and recorded. Sedation by 5-point sedation score, post-operative pain by faces, legs, activity, cry and consolability tool (FLACC) score were determined on emergence from anaesthesia and 1,2,4,6, 12, 24 h until the first dose of rescue analgesia was given in form of paracetamol suppository 15 mg/kg when the FLACC score was ≥4. Other adverse events such as nausea, vomiting, respiratory depression, bradycardia, hypotension, urinary retention, facial flushing and pruritus were also observed. The duration of analgesia was defined as the time period between administration of block until the time FLACC score reached ≥4. Results were collected and analysed.

The sample size was calculated based on anobservation made by Jo *et al*.,[10] they had taken three groups in their study as compared to two groups in this study. The sample size was calculated as 64 subjects for each of two groups at alpha error 0.05 and power 80%

assuming a difference of means to be detected in time of first rescue analgesic requirement in ropivacaine plain group and ropivacaine with dexamethasone of 10 min with expected standard deviation 20 min. Results were collected and statistically analysed by using Student's *t*-test. $P < 0.05$ were considered statistically significant.

RESULTS

The two groups were comparable with respect to age, weight and duration of surgery. Intraoperative haemodynamic parameters were maintained within 20% of base value in both the groups having no significant variation. The mean duration of analgesia in Group B was significantly more than in Group A, i.e., 478.046 ± 104.57 min and 248.4 ± 54.1 $P < 0.001$ respectively. When pain score was compared within two groups, it was observed that at 4, 6, 12 h, it was significantly higher in Group A as compared to Group B and in first 2 h there was no significant difference in pain scores. There were no significant adverse effects noted in the two groups.

DISCUSSION

Our study demonstrated a significant prolongation in the post-operative analgesia by adding dexamethasone to caudal ropivacaine. There was a decrease in pain score and demand for rescue analgesic requirement during 24 h post-operative period and time for first analgesic administration was significantly longer with dexamethasone.

The effect of IV dexamethasone in decreasing post-operative pain has been studied in children mainly in otolaryngological procedures with a wide range (0.4–1.0 mg/kg) of dexamethasone.[11-13] Variation in dosage of dexamethasone, type of surgery and anaesthetic techniques, use of opioids intraoperatively and different methods for assessing post-operative pain may be responsible for conflicting results obtained in these studies. In one study, IV dexamethasone in combination with caudal ropivacaine in paediatric orchiopexy was used and reduced severity of post-operative pain and prolonged analgesic duration were observed.[14]

Other studies where dexamethasone was used as an adjuvant to local anaesthetic via perineural[15] epidural[10,16,17] intrathecal[18] and caudal[11,19,20] and routes for various surgeries supported its role in potentiating and prolonging the analgesic effect.

We used dexamethasone with a preservative in the form of methyl paraben and propyl paraben. Epidural corticosteroids have been used safely since long in the treatment of low back and radicular pain.[20] The safety of methyl paraben and propyl paraben has been proven for intrathecal injection in human and animal models.[20]

The exact mechanism of epidural or perineural dexamethasone is not known, but it is believed to have local anaesthetic effect by direct membrane stabilising action on nerves.[21] Use of dexamethasone is more common because it is a clear liquid (non-particulate) steroid.[22] The effect of dexamethasone on the spinal cord is due to the presence of transcription factor nuclear factor-kappa B (NF-κB), present throughout the nervous system.[23] Dexamethasone by regulating NF-κB inhibits central sensitisation after surgery and potentiates analgesia of the caudal block.[24,25] Systemic administration of dexamethasone attenuates the level of bradykinin and by inhibiting phospholipase A29 and the expression of cyclo-oxygenase-2 in peripheral tissues and in the central nerves system resulting in decreased production of prostaglandins, contributing to analgesia. Until date, no significant adverse effects have been reported for epidural dexamethasone[26] and caudal dexamethasone.[11,19,20] We used 0.1 mg/kg of dexamethasone as an adjuvant to 0.2% caudal ropivacaine. Dose calculation of dexamethasone capable of producing analgesia was based on the previous studies.[10,16]

CONCLUSION

The addition of 0.1 mg/kg dexamethasone to caudal ropivacaine for paediatric herniotomies as a single shot injection resulted in a significantly longer duration of analgesia as compared to the use of ropivacaine alone, and the quality of analgesia was better after the first 2 post-operative hours, without any side effects.

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Conflicts of interest
There are no conflicts of interest.

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