

Research Article

Comparison of Analgesic Efficacy of Caudal Ropivacaine and Dexamethasone in Paediatric Patients Undergoing Infraumbilical Surgery

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Abstract: Background: Caudal analgesia is a good, reliable and easy method to provide intraoperative and postoperative analgesia in the infraumbilical surgery in paediatrics. This study aimed to compare perioperative analgesic efficacy, intraoperative hemodynamics and postoperative side effects of dexamethasone added to caudal ropivacaine in paediatric patients undergoing infraumbilical surgery. Methods: This study was conducted on 60 patients (30 in each group), either gender, age 1 to 7 yrs, ASA I to III, schedule for lower abdominal surgery. After giving general anaesthesia, caudal block was given in left lateral position. Patients in Group C received 1.0 ml/kg, 0.15% ropivacaine alone and in Group D 1.0 ml/kg, 0.15% ropivacaine with 0.2 mg/kg of dexamethasone. Postoperative duration analgesia (FLACC pain score) was assessed. Result: There was no statistically significant difference observed with respect to demographic data, peri-operative heart rate, systolic and diastolic blood pressure and requirement of sevoflurane % concentration in both the groups. After eight, 12 and 24 hours, mean FLACC score was significantly high in children of group C compared to group D ($P < 0.0001$). The mean duration of analgesia was significantly more in group D (946.15+165.42 min) as compared to group C (420.6+15.35 min) ($P < 0.0001$). No side effects were observed in any of two groups. Conclusion: Caudal administration of dexamethasone to ropivacaine significantly increased the duration of post-operative analgesia without any major side effects in children. In paediatric patients by using this simple and safe method, satisfactory analgesia can be provided.

Keywords: caudal, postoperative analgesia, infra-umbilical surgery, ropivacaine, dexamethasone.

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INTRODUCTION:

Epidural analgesia is a part of multimodal approach to acute and chronic pain management in children (Patel, D. 2006). Pain is associated with increase pain perception in subsequent painful experience and neurohormonal, behavioural responses which can be harmful (Peters, J. W. *et al.*, 2005).

Caudal blockade is the commonest regional technique used in children (Patel, D. 2006; Peters, J. W. *et al.*, 2005; & Ahmad, S. *et al.*, 2012). It produces dense, excellent peri-operative analgesia with minimal side effect. The technique is relatively reliable, simple, safe, very effective and easy to perform (Patel, D. 2006; & Hong, J. Y. *et al.*, 2010). Very minimum hemodynamic changes are seen after caudal block in children comparing to adults. Reasons are vasodilated systemic vasculature and low circulatory volume in legs and splanchnic system (Patel, D. 2006).

Ropivacaine is structurally related to bupivacaine. Compared to racemic bupivacaine, ropivacaine has lower central nervous system and cardio toxicity and better tolerated than bupivacaine (Reiz, S. *et al.*, 1989; Knudsen, K. *et al.*, 1997; & Scott, D. B. *et al.*, 1989).

To prolong the duration of local anaesthetics drug, adjuvant like dexmedetomidine, clonidine, fentanyl has been used (Patel, D. 2006; & Hong, J. Y. *et al.*, 2010). They have side effects like bradycardia, sedation or nausea vomiting (Neogi, M. *et al.*, 2010; & Sengupta, S. *et al.*, 2015).

Corticosteroids have been used by epidural and perineural route in adult to prolong postoperative analgesia (Jo, Y. Y. *et al.*, 2011; & Cummings III, K. C. *et al.*, 2011). Dexamethasone is used to reduce perioperative nausea and vomiting. It also has been reported to have analgesic effects.¹² Mechanism of analgesic effect is not known. It might be due to anti-

inflammatory effect and local anaesthetic effect on nerve by direct membrane action.

This randomized, prospective, interventional, double blind study was planned to compare the analgesic properties of dexamethasone 0.2 mg/kg as an adjuvant with ropivacaine 0.15% 1 ml/kg by caudal epidural in children undergoing infraumbilical surgery.

MATERIAL AND METHODS:

After ethical committee approval (No IEC/Certi/124/16) and written informed consent of patient's parents, prospective interventional double blind study was conducted on 60 paediatric patients undergoing infraumbilical surgery. Each group comprises of 30 patients, age between one to seven years, either gender, eight to 25 kg and ASA I to III. Paediatric patients of ASA status IV and V, emergency surgeries, local infection of the caudal area, history of allergic reactions to local anaesthetics, bleeding diathesis, pre-existing neurological or spinal diseases, mental retardation, neuromuscular disorders were excluded from the study.

Children were monitored for ECG, NIBP, SpO₂, temperature & EtCO₂. Intravenous pre-medication inj. glycopyrrolate 0.004 mg/kg was given. Induction of anaesthesia was done using inhalation method 100% oxygen with Sevoflurane 2 to 7%. I-gel insertion was facilitated by inj. succinyl choline 2 mg/kg. Anaesthesia was maintained with 50% O₂, 50% N₂O, Sevoflurane (1 to 2%) and/or inj. atracurium 0.5 mg/kg. Random selections done by close envelop

method. Anaesthesiologist who did caudal block was unaware of the drug injected. Caudal epidural was performed with 22 gauge epidural needle under complete aseptic precaution with child in a left lateral position. After confirmation and negative aspiration for blood and CSF, the study drugs were injected.

Group C - 1.0 ml/kg, 0.15% ropivacaine alone

Group D - 1.0 ml/kg, 0.15% ropivacaine with 0.2 mg/kg dexamethasone

Intra-operatively no analgesia was supplemented. Perioperative hemodynamic parameters NIBP, heart rate, SpO₂ and EtCO₂ were recorded at every 15 minutes till end of surgery. During surgery adequate analgesia was evaluated by hemodynamic changes (change in heart rate and systolic blood pressure at above or below 15% of baseline values) and requirement of sevoflurane concentration. An increase in heart rate and systolic blood pressure after 15 to 20 minutes of caudal block was considered as a failure of caudal anaesthesia. At the end of surgery, neuromuscular blockade was reversed with inj. neostigmine 0.05 mg/kg and inj. glycopyrrolate 0.008 mg/kg. Duration of surgery, duration of anaesthesia, requirement of inhalation agent and complications like bradycardia, tachycardia, hypotension, hypertension, vomiting and delayed motor recovery were recorded. Postoperative pain was evaluated by using FLACC score (maximum score of 10) (Table 1) at one hour interval for first three hours and thereafter every two hours interval till score more than three for 24 hours and rescue analgesic was given.

Table 1: FLACC postoperative pain score

| Categories | Scoring 0 | Scoring 1 | Scoring 2 |
|---------------|--|---|---|
| Face | No particular expression or smile | Occasional grimace or frown, withdrawn, 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, frequent complaints |
| Consolability | Content, relaxed | Reassured by occasional touch or hugging or being talked to | Difficulty to console or comfort |

Statistical Analysis:

Data were described as mean ± SD and percentages. For comparing data between two groups, unpaired student t test was used and p value < 0.005 calculated using IBM-SPSS (Statistical Package Social of Sciences) software. P value < 0.05 was interpreted as clinically significant.

RESULTS:

Demographic data, mean duration of surgery and anaesthesia and type of surgery are comparable in both groups. (Table 2).

Table 2: Demographic Data

| | Group C (No=30) (%) | Group D (No=30) (%) | P value |
|--|--------------------------------|--------------------------------|----------------|
| Age (Years) (Mean± SD) | 3.16 ± 1.47 | 2.98 ± 1.51 | 0.6417 |
| Weight (Kg) (Mean± SD) | 10.56 ± 3.18 | 10.06 ± 3.08 | 0.5386 |
| Gender (M:F) - Number (%) | 28:2 (93:7) | 26:4 (87:13) | 0.6629 |
| ASA grade (I:II) - Number (%) | 18:12 (60:40) | 17:13 (57:43) | 1.000 |
| Mean duration of Surgery (Minutes) | 87.5 ± 7.36 | 91±8.03 | 0.160 |
| Mean duration of Anaesthesia (Minutes) | 100.83 ± 10.26 | 102.16±9.06 | 0.596 |
| Types of Surgery - Number (%) | | | |
| Hypospadiasis repair | 10 (33.3%) | 12 (40%) | |
| Herniotomy | 14 (47%) | 15 (50%) | |
| Orchidopexy | 06 (20%) | 03 (10%) | |

Statistically no significant changes were observed in peri-operative heart rate (Figure 1) and systolic and diastolic blood pressure (Figure 2) in both groups.

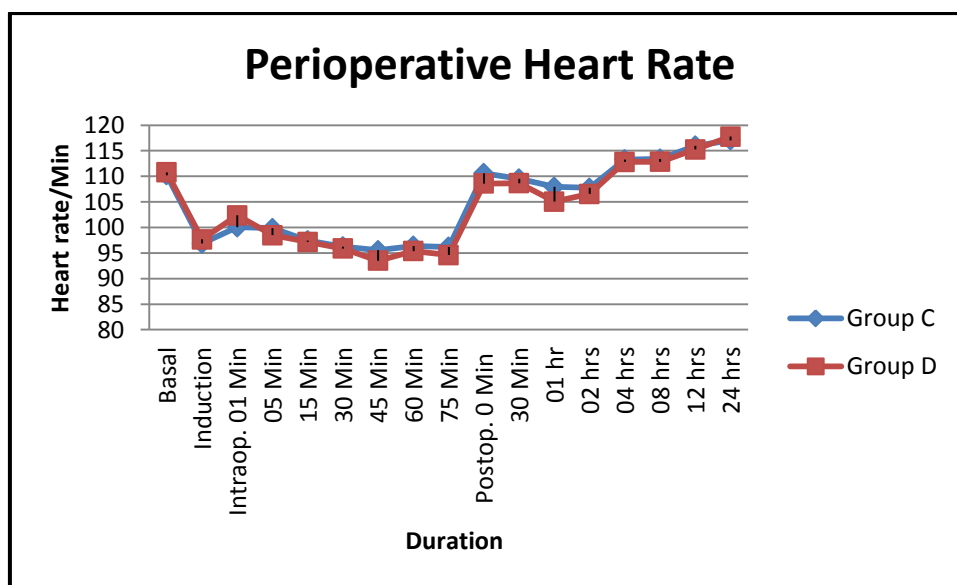


Figure1: Peri-operative heart rate

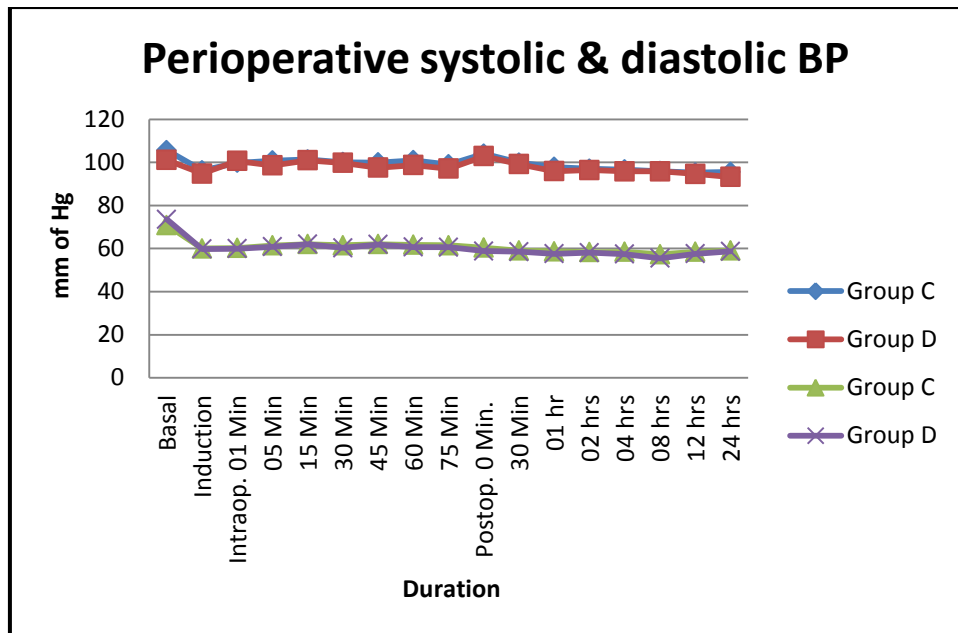


Figure 2: Peri-operative systolic and diastolic BP

There was no statistical difference in requirement of intra-operative concentration of sevoflurane % in both the groups. (Figure 3)

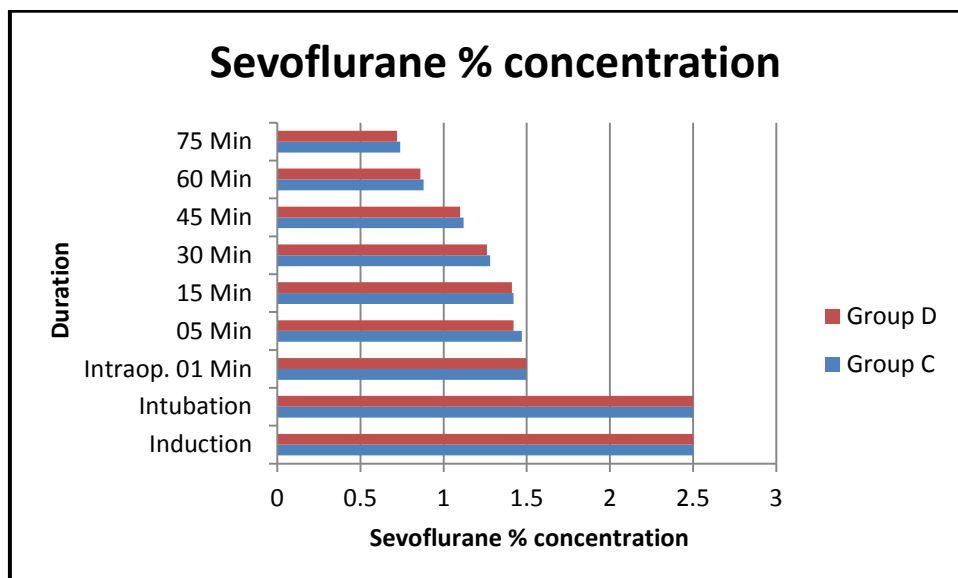


Figure 3: Intraoperative sevoflurane % concentration

Mean FLACC score at postoperative one, two and four hours between the two groups were comparable ($P > 0.05$). After eight, 12 and 24 hours, mean FLACC score was significantly high in children of group C compared to group D ($P < 0.05$). (Figure 4)

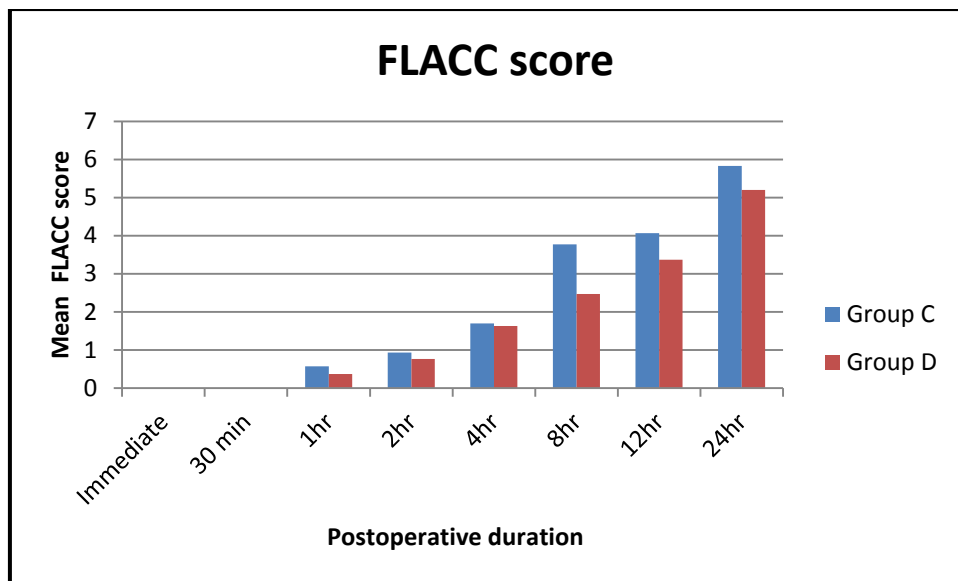


Figure 4: Postoperative FLACC Pain Score

Mean duration of analgesia was significantly prolonged in group D (946.15min) in comparison to group C (420.6min) ($P < 0.0001$). (Figure 5)

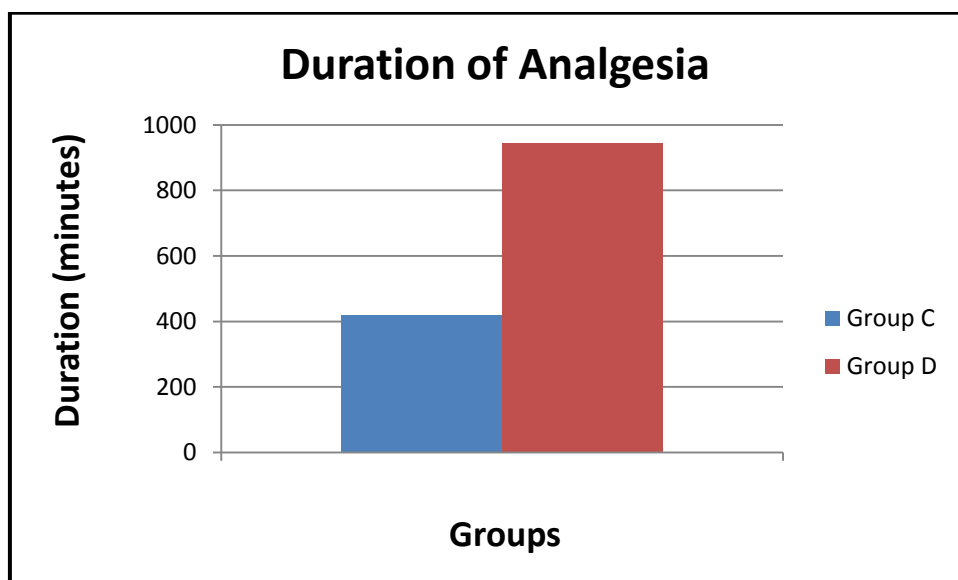


Figure 5: Mean duration of post-operative analgesia

Complications like nausea, vomiting, pruritis, sedation, respiratory depression, delayed motor recovery was not observed in any patient.

DISCUSSION:

The important goal in paediatric patient is to provide effective postoperative analgesia for considerable duration. It is difficult to differentiate restlessness or crying due to pain from that of hunger or fear (Neogi, M. *et al.*, 2010). Caudal blockade is commonly used popular regional technique in children. It is simple and safe and produces dense peri-operative analgesia with high success rate (Patel, D. 2006; Neogi, M. *et al.*, 2010; & Johnsson, A. *et al.*, 1990).

This present study demonstrates a significant prolongation in postoperative analgesia by adding 0.2 mg/kg dexamethasone to caudal 0.15% ropivacaine 1 ml/kg in children undergoing infraumbilical surgery. Up to eight hours postoperatively, mean FLACC score was less than three in group D compared to group C.

Ropivacaine is a new amide local anaesthetic having similar profile to equipotent doses of bupivacaine (Cummings III, K. C. *et al.*, 2011). It provides excellent postoperative analgesia by epidural or perineural approach. It has less intrinsic toxicity, so its margin of safety increases compared to other local

anaesthetics (Ahmad, S. *et al.*, 2012; & Cummings III, K. C. *et al.*, 2011).

Dexamethasone is commonly used in the perioperative period to reduce postoperative nausea and vomiting and also for an analgesic effect.¹² Antiemetic action of dexamethasone is via prostaglandin antagonism, serotonin inhibition in the gut and release of endorphins.⁴ Mechanism of analgesic effect of dexamethasone may be by direct membrane action (Johnsson, A. *et al.*, 1990). Systemic administration of steroids found to suppress tissue levels of bradykinin and release of neuropeptides from nerve endings. The established reduction in prostaglandin production inhibit synthesis of cyclooxygenase isoform 2 in peripheral tissues and central nervous system might contribute to analgesia (Ferreira, S. H. *et al.*, 1997). The transcription nuclear factor κ B (Nf- κ B) present in nervous system. It plays role in pathological pain. Dexamethasone regulates it and prevents central sensitization and produce analgesia of caudal block (Niederberger, E., & Geisslinger, G. 2008; & De Bosscher, K. *et al.*, 2003).

Placing the block before the surgical incision provides intraoperative pain relief, reduces the general anaesthetic requirement, and affords earlier recovery of airway reflexes (Hannallah, R. S. *et al.*, 1997). In our study caudal block was given before surgical incision. There was no statistical difference in requirement of intra-operative concentration of sevoflurane % in both the groups.

In our study the mean duration of analgesia was significantly prolonged in group D (946.15+165.42 min) in comparison to group C (420.6+15.35 min) ($P < 0.0001$). Mean FLACC score at postoperative one, two and four hours between the two groups were comparable. Mean FLACC score after eight hours was 2.47+0.68 in group D and 3.77+0.43 in group C ($P < 0.0001$). In our study hemodynamic parameters remained within 20% of baseline value in both the groups.

Caudal 0.2% ropivacaine with 0.1 mg/kg dexamethasone shows significantly prolong postoperative analgesia in dexamethasone group (478.046 \pm 104.57 min) compared to ropivacaine group (248.4 \pm 54.1min) ($P < 0.001$). Higher FLACC pain score observed at four, six, 12 hours in plain ropivacaine group as compared to dexamethasone group. Study shows no significant variations in haemodynamic parameters in both the groups (Choudhary, S. *et al.*, 2016). Study of caudal 0.15% ropivacaine with 0.1 mg/kg dexamethasone mentioned significantly lower postoperative pain scores at six and 24 hours after surgery (Sree, M. S. *et al.*, 2014), increases the analgesic duration, pain severity and reduced postoperative requirement of analgesic for 48 hours in dexamethasone group as compared to plain ropivacaine

group (Sree, M. S. *et al.*, 2014; Yousef, G. T. *et al.*, 2014; & Kim, E. M. *et al.*, 2014). No significant difference in intraoperative hemodynamic parameters were observed in both groups (Choudhary, S. *et al.*, 2016; Sree, M. S. *et al.*, 2014; & E. M. *et al.*, 2014). However duration of postoperative analgesia was significantly higher in our study. It can be because in our study dexamethasone dose is 0.2 mg/kg. Study comparing caudal dexamethasone, dexmedetomidine and fentanyl added to local anesthetics mentioned less pain score, less side effects and prolong duration of analgesia in caudal dexamethasone and dexmedetomidine group compared to caudal local anaesthetic alone or added to caudal fentanyl (El-Feky, E. M., & Abd El Aziz, A. A. 2015).

Adverse effects of dexamethasone such as hyperglycaemia and adrenal suppression was not evaluated in our study. Previous studies have demonstrated that a single small dose of dexamethasone is not associated with significant side-effects (Ahadian, F. M. *et al.*, 2011).

Effect of IV dexamethasone of 0.5 mg/kg with caudal ropivacaine (Hong, J. Y. *et al.*, 2010) or only 0.4 to 1.0 mg/kg IV dexamethasone after tonsillectomy reduces postoperative pain in children (Giannoni, C. *et al.*, 2002).

There is no difference in quality and duration of analgesia using ropivacaine (0.25%, 1 ml/kg) compared with bupivacaine (0.25%, 1 ml/kg) (Khalil, S. *et al.*, 1999).

Ropivacaine is comparable to (or slightly more potent than) bupivacaine in blocking sensory fibres and less active in blocking motor fibres with increased margin of safety particularly in younger children (Ahmad, S. *et al.*, 2012).

Administration of dexamethasone with local anaesthetic by various routes potentiates and prolongs the analgesic effect. Dexamethasone prolongs analgesia from interscalene blocks using ropivacaine or bupivacaine (Cummings III, K. C. *et al.*, 2011). Administration of 5 mg of dexamethasone epidurally (Jo, Y. Y. *et al.*, 2011) or intrathecal (Bani-Hashem, N., *et al.*, 2011) reduce analgesic requirement and prolong the duration of analgesia.

E.M Kim *et al.*, mentioned no significant difference in sevoflurane concentration (end tidal vol%) in dexamethasone group and plain ropivacaine group. To maintain adequate depth of anaesthesia, five minutes after skin incision sevoflurane concentration was 2.6% in dexamethasone group and 2.7% in plain ropivacaine group. Similarly, at the end of surgery it was 2.0% in group D and 2.2% in group R (Kim, E. M. *et al.*, 2014). In our study also there was no significant difference in

concentration of sevoflurane required to maintain adequate depth of anaesthesia in both groups.

We did not observe any significant adverse effects in both the groups. Low lipid solubility and high pKa (8.1) of ropivacaine causes blockade of A delta and C fibres supplying pain and touch sensation to a greater extent than that of the A α and A β fibres supplying motor sensation. This leads to quicker motor recovery (Mohan, S. K. *et al.*, 2016).

CONCLUSION:

Hence we find that addition of 0.2 mg/kg dexamethasone to 0.15% ropivacaine for caudal block is safe and significantly improve analgesic efficacy in children undergoing infraumbilical surgery.

Conflict of interest: Nil

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