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Original Article

Comparison of Caudal Anesthesia and Ilioinguinal Block for Pediatric Inguinal Surgeries and Post-operative Analgesia

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Abstract

Background and Objective: Infants and children undergo a variety of groin procedures that can cause a significant degree of discomfort postoperatively. We aim to compare the caudal block and ilioinguinal/iliohypogastric block using the combination of ropivacaine and dexmedetomidine with regard to efficacy, quality, and duration of post-operative analgesia.

Methods: This study included two groups and 60 patients of the age group of 3–12 years. After induction of anesthesia, Group A received caudal block using 1 ml/kg 0.2% ropivacaine + dexmedetomidine 0.3 μg/kg up to maximum of 20 ml. Group B received nerve locator guided ilioinguinal/iliohypogastric block using 0.75 ml/kg 0.2% ropivacaine + dexmedetomidine 0.3 μg/kg up to maximum of 20 ml. Postoperatively, patients were monitored for up to 24 h for primary objective of measurement of pain score, duration of analgesia, and number of rescue analgesia required. Statistical analysis performed using independent *t*-test and Chi-square test. $P < 0.05$ was considered statistically significant.

Results: The highest pain score in Group A was 5.93 ± 1.53 and in Group B was 4.93 ± 1.64 ($P < 0.05$). The average duration of analgesia in Group A and Group B was 372 min and 680 min, respectively ($P < 0.05$). The mean number of rescue analgesia given in Group A was 1.47 and in Group B was 0.96 ($P < 0.05$).

Conclusion: Both caudal block and ilioinguinal block are effective measure of post-operative pain relief in pediatric inguinal surgeries, but ilioinguinal block is better in terms of efficacy, duration of analgesia, lesser dose of local anesthetic required, and lesser need of rescue analgesia required.

Key words: Caudal block, Ilioinguinal block, Pediatric anesthesia, Post-operative analgesia

INTRODUCTION

Pain is, perhaps, the most feared symptom of disease, which a man is always trying to alleviate and conquer since ages. For decades, children and infants were considered to be insensitive to pain.[1] The current evidence suggests that severe pain in children has significant long-term effects. An effective pain therapy to block or modify the myriad physiologic responses to stress has become an essential component of modern pediatric anesthesia.

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There is substantial evidence that pain is undertreated in children.[2] The concept of post-operative pain relief and its utilization in the pediatric age group has improved dramatically over recent years. The various methods of providing pain relief have some side effects which prohibit their use in children, for example, narcotics due to their respiratory depression; oral analgesics after general anesthesia due to the fear of vomiting and aspiration; the objection to the needles in the case of parenterally administered analgesics.

Infants and children undergo a variety of groin procedures that can cause a significant degree of discomfort postoperatively. The most commonly performed inguinal surgeries in children include inguinal hernia repair with or without orchidopexy. For post-operative pain relief due to these surgeries, a regional analgesic modality such as caudal

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analgesia, inguinal and iliohypogastric nerve block, or local infiltration is combined with general anesthesia. When compared to intravenous (IV) opioids, regional techniques reduce the risk of side effects such as somnolence, respiratory depression, emesis, and ileus.

Caudal block involves the introduction of local anesthetic (LA) into the caudal epidural space and is a common practice to administer under deep sedation or a general anesthesia. Inguinal nerve block including ilioinguinal and iliohypogastric nerve blocks can provide effective ipsilateral analgesia. A single injection often blocks both the nerves. Landmark techniques can result in technical failure and also increase the chances of side effects due to the higher dose given.[3] This can be improved using peripheral nerve locators or ultrasound guidance.

LAs are drugs that inhibit conduction in peripheral nerves and these are being used in regional anesthesia. Ropivacaine is a long-acting LA that is structurally related to bupivacaine. It is a pure S-enantiomer developed for reducing potential toxicity and improving relative sensory and motor block profiles.[4]

There are various adjuncts added to LA s which prolong the duration of action of LA s, thus providing post-operative analgesia. Dexmedetomidine is an alpha-2 agonist having greater affinity for alpha-2 adrenergic receptors and much less alpha-1 effects which is responsible for the hypnotic and analgesic effects. Dexmedetomidine possesses anxiolytic, sedative, sympatholytic, and analgesic properties without respiratory depressant effect.[5]

This present study was designed to compare the efficacy and duration of caudal analgesia and ilioinguinal/iliohypogastric nerve blocks for post-operative analgesia in pediatric population undergoing unilateral inguinal surgeries.

METHODS

The present study was a randomized observational study conducted prospectively on 60 patients in the age group of 3–12 years of either sex of the American Society of Anesthesiologists Grades I and II.

After oral premedication with midazolam 0.5 mg/kg and standard monitoring (electrocardiogram, pulse oximetry, and non-invasive arterial blood pressure [BP]), IV access will be established, general anesthesia was induced with propofol (dose 2–2.5 mg/kg), and anesthesia was be maintained with one minimum alveolar anesthetic concentration halothane in O_2 and nitrous oxide. The children breathed spontaneously through i-gel airway and if necessary respiration was assisted to maintain an $etCO_2$ of 35–45 mmHg. Thereafter, children were divided into two groups of 30 each in a random and unbiased manner. The first group (Group A) received caudal block and the second group (Group B) received ilioinguinal/iliohypogastric block.

The technique of caudal epidural block involves palpation, identification, and puncture. The lateral position is efficacious in pediatrics. A triangle was marked on the skin over the sacrum, using the posterior superior iliac spines as the base, with the apex pointing caudally. Sacral hiatus was marked. A sterile skin preparation and draping of the entire region were performed. An 18-gauge Tuohy-type needle was inserted either in the midline into the caudal canal. A feeling of a slight "snap" was appreciated when the needle pierced the sacrococcygeal ligament. Once the needle reached the ventral wall of the sacral canal, it was slowly withdrawn and reoriented, directing it more cranially for further insertion into the canal. A Whoosh test was done for identifying correct needle placement in the caudal canal. Group A, thus, received caudal block with 0.2% ropivacaine 1 ml/kg combined with dexmedetomidine 0.3 μg/kg.

For ilioinguinal block, after the area was painted and draped, the Locoplex needle was inserted at a point 2.5 mm (range 1.0–4.9 mm) medial and inferior to anterior superior iliac spine, the needle was slowly advanced until there was loss of resistance which occurred as external oblique aponeurosis was pierced. It was checked if the electrical circuit is complete indicated by a flashing light or an audible bleep. The initial current amplitude between 1.5 and 3 mA for a period of 0.1–0.3 ms elicit a muscle response at a safe distance from the nerve. The current intensity amplitude was gradually reduced and the needle was advanced further slowly. Once the desired twitch was obtained, the needle was carefully manipulated, while reducing the current until the twitch disappeared. Persistence of twitching at a current <0.2 mA may indicate possible intraneural needle placement. Obtaining a twitch at a current <0.4 mA but not <0.2 mA indicates correct placement of needle. The needle was now held immobile and 1 ml of the LA is injected. At this point, the twitching should disappear. Once it was confirmed that the needle tip is not inside a nerve or a vessel, 0.75 ml/kg of 0.2% ropivacaine combined with dexmedetomidine 0.3 μg/kg was injected.

After the successful application of either caudal or ilioinguinal block, the surgery was allowed to proceed under standard monitoring. After the completion of surgery, patient was shifted to post-operative care area and monitored at different intervals up to 24 h.

The parameters monitored except for standard monitoring were as follows:

1. Wong-Baker Faces Pain Rating Scale
   The child was asked to choose face that best describes own pain and the appropriate number recorded.
2. Objective pain scale
   Scores five different parameters; systolic BP, agitation, movement, cry and complaint of pain from 0 to 2, and total score calculated.
3. Rescue analgesia
   If Wong-Baker pain score >4 and objective pain scale >4, then rescue analgesia in the form of syrup paracetamol 15 mg/kg was given.
4. Side effects

RESULTS

The data were collected, compiled, and analyzed statistically. Sample size was analyzed keeping in view at most 5% risk with minimum 85% power and 5% significance level. Unpaired *t*-test was used to analyze. Significance level was evaluated by knowing *P* value. $P > 0.05$ was considered statistically non-significant; $P = 0.01–0.05$ was considered statistically significant; and $P < 0.01$ was considered highly statistically significant. The results were examined and compared with literature results (SPSS 22 version of software was used, IBM Corp., 2013, Armonk, NY, USA).

With respect to the demographic parameters, the patients in both the groups were analogous as is evident from Table 1. The duration of surgery in Group A was 38.50 ± 7.21 min and in Group B was 39.50 ± 7.91 min. The difference was statistically non-significant ($P > 0.05$). Baseline hemodynamic parameters were also statistically and clinically insignificant ($P > 0.05$).

There was a fall in heart rate in Group A as compared to Group B in the intraoperative period, that is, immediately after the block. There was change in mean heart rate in post-operative period corresponding to the change in pain scale. The difference between the two groups, however, was statistically non-significant throughout intra- and post-operative period.

In our study, the mean baseline systolic BP in Group A was 87.13 ± 12.50 mmHg and in Group B was 86.53 ± 11.30 mmHg and mean difference was comparable. There was an initial fall in systolic BP in Group A from baseline value of 87.13 ± 12.50 mmHg to 84.20 ± 11.99 mmHg at 20 min. Similar to heart rate in the post-operative period, there was change in mean systolic BP corresponding to the change in pain scale. The difference between the two groups was statistically non-significant.

Various other hemodynamic parameters were statistically comparable during intraoperative and post-operative period.

The patients in Group A started showing increase in Wong-Baker Faces pain score ≥4 after 4 h and maximally at 6 h. The mean and standard deviation at 6th h in Group A was 5.93 ± 1.51 and in Group B was 3.80 ± 0.81. On analysis using Student's *t*-test, it came out to be highly significant. Rescue analgesia was given to patients in Group A at 6th h and 10th h. Rescue analgesia to patients in Group B was given at 8 h as shown in Figure 1.

The patients in Group A started showing increase in objective pain score ≥4 after 4 h and maximally at 6 h. The mean and standard deviation at 6th h in Group A was 5.30 ± 1.20 and in Group B was 3.97 ± 0.84. Rescue analgesia was given to Group A at 6 h after which pain score decreased to 4.07 ± 0.85. It again increased at 10 h. The maximum score in Group B was at 8 h which was 4.60 ± 1.54 and decreased after rescue analgesia as shown in Figure 2.

The mean dose of rescue analgesia needed in Group A was 1.47 ± 0.51 and in Group B was 0.97 ± 0.96. The difference between mean of two groups was compared and was statistically significant with $P < 0.001$.

The number of patients who needed two doses of rescue analgesia in Group A was 14 (46.7%). In Group B, there

Table 1: Rescue analgesia required in two groups

Number of rescue analgesia needed	Number of cases (%)		
	Group A	Group B	Total
0	0 (0)	5 (16.7)	5 (8.3)
1	16 (53.3)	20 (66.7)	36 (60)
2	14 (46.7)	5 (16.7)	19 (31.7)

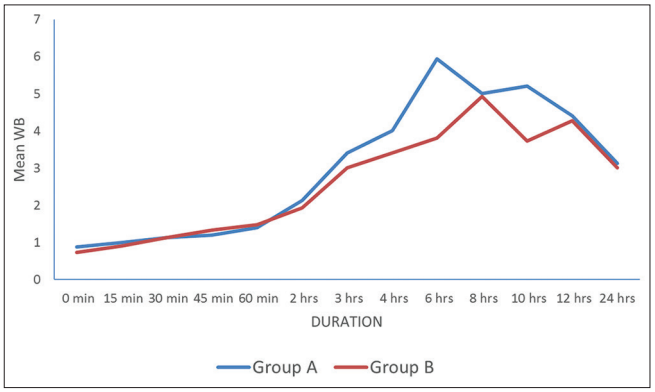

Figure 1: Mean Wong-Baker Faces Pain scale at different time intervals

were five patients who needed the 2nd dose of rescue analgesia. In Group A, there were 16 (53.3%) patients who needed one dose of rescue analgesia and in Group B 20 (66.7%) patients needed one dose of rescue analgesia. Five patients from Group B required no rescue analgesia in the first 24 h of post-operative period as shown in Table 1.

The mean duration of analgesia in Group A was 372 ± 87.4 min (mean 6.2 h) and in Group B was 680 ± 120.9 min (mean 11.3 h). The difference in their mean was analyzed statistically using Student's *t*-test and it was highly significant with $P < 0.001$ as shown in Table 2.

There was one patient in Group A who had retching and vomiting in the post-operative period. In remaining patients, the intraoperative and post-operative period was uneventful without any side effects.

DISCUSSION

Caudal block is an effective method of pain relief in post-operative period. However, its complications do exist such as bone marrow puncture, intestinal damage, and the danger of an increase of the blood concentration, and these complications can lead to systemic toxicity. Central nervous system disorders, spinal deformities, inflammation of the block site, and coagulation disorders are counterindications for caudal anesthesia, so it is necessary to find a substitute to control pain.[6]

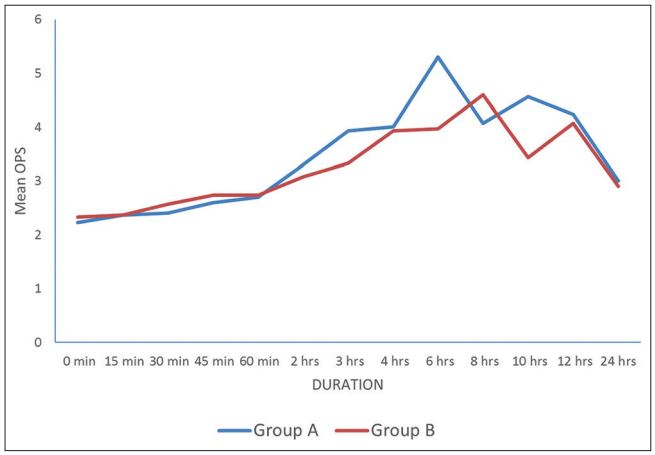

Figure 2: Mean objective pain scale at different time intervals

Table 2: Mean duration of analgesia

Group	Mean±SD (min)	*P* value with significance
A	372.0±87.4	0.000 HS
B	680.0±120.9	

SD: Standard deviation, HS: Highly significant

The ilioinguinal/iliohypogastric block is an attractive alternative to caudal block to provide post-operative analgesia in inguinal surgeries.

The aim of our study was to compare the caudal block and ilioinguinal block for post-operative analgesia with respect to quality, efficacy, duration, and requirement of rescue analgesia in children undergoing inguinal surgeries.

The drugs used in our study were a combination of 0.2% ropivacaine 1 ml/kg and 0.3 μg/kg of dexmedetomidine. This was similar to the study done by Smith *et al.* who evaluated the pharmacokinetics of ropivacaine 0.2% in children after caudal epidural injection. No clinical signs of LA toxicity were observed.[7]

The traditional recommended volume of LA required for ilioinguinal block is 1 ml/kg. This volume and thus dose required can be decreased by nerve locator guided techniques which recommend a volume of 0.7–0.9 ml/kg.[8] Thus, the requirement of LA dose is less in ilioinguinal/iliohypogastric nerve block when compared with caudal block (1–2 ml/kg body weight). Therefore, as the drug given is less, we assumed that the plasma level of LAs will be lesser in ilioinguinal block, therefore, lesser related side effects.

Various hemodynamic parameters were comparable statistically between both the groups during intraoperative and post-operative period. There was an initial fall in BP and heart rate in caudal block immediately after the block. In the post-operative period, all the hemodynamic parameters showed rise corresponding to pain scores.

In our study, the patients in group caudal block started showing increase in pain score ≥4 after 3 h and maximally at 6 h when Wong-Baker Faces pain scale were compared between two groups. The mean and standard deviation at 6th h in group caudal was 5.93 ± 1.51 and in group ilioinguinal block was 3.80 ± 0.81. The difference in the pain scores was statistically significant at 4 h, 6 h, and 10 h.

The objective pain scale measured at different time intervals in our study showed that the patients in group caudal started showing increase in pain score ≥4 after 4 h and maximally at 6 h. The mean and standard deviation at 6th h in group caudal block was 5.30 ± 1.20 and in group ilioinguinal block was 3.97 ± 0.84. On analysis, it came out to be significant at 8th and highly significant at 6th and 10th h.

In a study done by Kamal *et al.*[9] comparing the analgesic effects and side effects of dexmedetomidine added to ropivacaine in pediatric patients undergoing lower

abdominal surgeries, all patients in both groups had adequate analgesia Face legs activity cry consolability scale (FLACC score <4) initially. At 6 h postoperative, 60% of the patients in group ropivacaine alone achieved a FLACC score of ≥4 as compared to 0% of patients in group ropivacaine+dexmedetomidine, whereas 60% of the patients in group RD achieved a FLACC score of ≥4 at 18 h postoperative.

In a study done by Hannallah et al. [10] to compare effectiveness of caudal block and ilioinguinal block for post-orchiopexy pain show a comparable mean pain score in both the groups with a value of 2.5 ± 6 at 4 h postoperatively.

A similar study by Cross and Barrett[11] comparing caudal and ilioinguinal block shows a mean pain score of 5.7 ± 11.6 in caudal group and mean 5.7 ± 10.8 in ilioinguinal group at 3 h postoperative.

Quality of analgesia as compared by Ravi *et al.*[12] in caudal versus ilioinguinal group by FLACC scale found slightly lower scores in ilioinguinal/iliohypogastric nerve block when compared to caudal block.

Furthermore, Seyedhejazi *et al.*[13] have conducted a study comparing the analgesic effect of caudal and ilioinguinal/iliohypogastric nerve blockade using bupivacaine-clonidine in inguinal surgeries in children and foun d the quality of analgesia slightly more with ilioinguinal group when compared to caudal block group.

The duration of analgesia, given by pain score <4, in our study, was found out to be 372 ± 87.4 min (mean 6.2 h) in caudal block group and 680 ± 120.9 min (mean 11.3 h) in ilioinguinal block group. The average time to the first rescue analgesia was longer and the duration of analgesia was more in Group B, that is, ilioinguinal block group. This can be expected as uptake of drug is faster from the epidural space.

Anand *et al.*[14] administered dexmedetomidine in a dose of 2 μg/kg as an adjuvant with 0.25% ropivacaine caudally and observed that the duration of analgesia was significantly higher in the group receiving ropivacaine-dexmedetomidine mixture (14.5 h [13.90–15.09]) than the group receiving ropivacaine alone (5.5 h [4.97–6.03]).

Similarly, El-Hennawy *et al.*[15] administered dexmedetomidine and clonidine, both in a dose of 2 μg/kg as an adjuvant with 0.25% bupivacaine caudally. They found that the duration of analgesia was significantly higher in the group receiving bupivacaine-dexmedetomidine mixture (median 16 h) or bupivacaine-clonidine mixture (median 12 h) than the group receiving bupivacaine alone (median 5 h).

In a study done by Ravi *et al.*[12] to assess ultrasound-guided ilioinguinal/iliohypogastric nerve block using 0.1 ml/kg of 0.25% bupivacaine versus caudal block using 0.7 ml/kg of 0.25% bupivacaine shows the duration of post-operative analgesia being 4.95 ± 0.51 for ilioinguinal block and 4.78 ± 0.49 for caudal block group.

Hannallah *et al.*[10] proved that there are no differences in the post-operative analgesic effects between caudal blocks and ilioinguinal-iliohypogastric nerve blocks postorchiorrhaphy. Bhattarai *et al.*[16] concluded that simplified ilioinguinal/iliohypogastric nerve blocks in combination with small volume LA wound infiltration offer longer mean duration of analgesia and better safety margin to start oral analgesics than caudal block with LA alone in children undergoing herniotomy.

Our study shows that the mean number of rescue analgesia needed in Group A was 1.47 ± 0.51 and in Group B was 0.97 ± 0.96 the difference being significant ($P < 0.05$). The average time for first rescue analgesia in Group A was 372 ± 87.4 min (mean 6.2 h) and in Group B was 680 ± 120.9 min (mean 11.3 h). There were five cases in ilioinguinal block group who did not require any rescue analgesia in the first 24 h of post-operative period.

Saadawy *et al.*[16] observed in their study that 77% of the children in the bupivacaine-dexmedetomidine group versus 10% in group bupivacaine for caudal block did not require additional analgesia and total post-operative analgesic requirements for oral paracetamol were significantly less in the BD group ($P < 0.01$) during the first 24 post-operative hour.

In a study done by Abdellatif[17] comparing Ultrasonography-guided ilioinguinal block and caudal block shows that there was a difference in the doses of post-operative pain rescue medication administered to the studied groups. Mean number of rescue analgesia required in ilioinguinal block was 0.65 and in caudal block group was 0.74. AQ1

In our study, there was one patient in Group A who had retching and vomiting in the post-operative period. In remaining patients, the intraoperative and post-operative period was uneventful without any side effects. There was not any incidence of urinary retention in any of the group. Significant hypotension and bradycardia were not seen in any of the patients. There was not any case of post-operative respiratory depression.

In our study, we concluded that:

1. Both ilioinguinal block and caudal block are safe and effective method of analgesia in intraoperative and post-operative period in pediatric inguinal surgeries

2. In comparison to caudal block, nerve locator guided ilioinguinal block provides longer duration of analgesia. Furthermore, the requirement for rescue analgesia is lesser in ilioinguinal nerve block as compared to caudal block. Ilioinguinal block is thus more effective in terms to quality and duration of analgesia despite the lesser dose of LA required
3. The dose of LAs required for ilioinguinal block is less than that of caudal block. Therefore, there are lesser side effects
4. Combination of ropivacaine and dexmedetomidine for caudal and ilioinguinal block provides effective analgesia without increasing the incidence of side effects.

The limitations of our study are as follows:

- The mean age of our population is 6.03 years. These children might not be able to express their painfully to observer or to the parents
- The other limitations of the study are lack of standardization. There are a variety of groin procedures studied, leading to a variety of visceral pain manifestations that may have translated to either increased or decreased pain scores
- Plasma levels of drugs were not done in our study which could le ad to comparison of systemic effects of the drugs and the associated side effects.

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