*Original Article*

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# Comparision of the Postoperative Analgesic Efficacy of Bupivacaine 0.125% 1ml/kg versus Bupivacaine 0.125% 1ml/kg and Fentanyl 1 µg/kg for Caudal Analgesia in Paediatric Patients undergoing Short Surgical Procedures

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**Abstract**

*Aims:* To compare the postoperative analgesic efficacy of bupivacaine 0.125%1ml/kg versus bupivacaine 0.125% 1ml/kg and fentanyl 1 µg/kg for caudal anaesthesia in paediatric patients undergoing short surgical procedures. *Settings and Design*: Sixty children in the age group 1-6 years posted for routine paediatric short surgical procedures below the umbilicus were included. The data was collected in the prepared proforma consisting of age, sex, etc. meeting the objectives of the study. *Patients and Methods*: The 60 children were randomly divided into two groups of 30 each. Group I received 1ml/kg of 0.125% bupivacaine and Group II received 1ml/kg of 0.125% bupivacaine plus fentanyl 1µg/kg for caudal block. Postoperative analgesic efficacy was compared between two groups. *Statistical Analysis*: was done using students't' test and chi-square test. *Results*: The maximum total duration of analgesia noted among both groups I and II was 510 minutes. Mean total duration of analgesia was 341.5±68.23 min in group I, whereas it was 401.5 ± 44.8 min in group II. The mean total duration of analgesia was more in group II, than in group I, which was statistically significant ($p < 0.05$). *Conclusion*: The total duration of postoperative analgesia was significantly longer in children receiving 0.125% bupivacaine 1ml/kg plus fentanyl 1µg/kg (401.5±44.89 minutes) than in children receiving 0.125% bupivacaine 1ml/kg alone. (341.5±68.23 minutes). Group II children received less number of rescue analgesics than children in Group I in 24 hours period (postoperative).

**Keywords**: Postoperative Analgesia; Caudal Epidural Block; Paediatric Analgesia; Duration of Analgesia; Short Surgical Procedures.

## Introduction

Pain is defined by the international association for study of pain as an "unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" [1]. An unproved safety and efficacy of the analgesics and worries about the risk of opioid induced respiratory depression, added more reasons for the undertreatment of pain in children [2]. Under treatment of postoperative pain even in the children and newborns may trigger biochemical and physiologic stress response and cause impairments in pulmonary, cardiovascular, neuroendocrinal, gastrointestinal, immunological and metabolic functions [3]. Langlade et al [4] suggested that the postoperative pain treatment must be included in the anaesthetic planning even before induction of anaesthesia, adopting the idea of "managing pain before it occurs". Child's self report is the single most reliable indicator of the existence and intensity of pain [2]. Caudal block is the regional technique that is used with the greatest frequency in pediatric patients. It has been shown that caudal anesthesia suppresses the metabolic and endocrine responses to stress associated with lower abdominal and genitourinary surgery in children [5]. Bupivacaine is the commonly used local anaesthetic for caudal block in children. Several

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studies have examined the effects of adding morphine or fentanyl to caudally administered local anaesthetic, some of which appeared to show an improvement in postoperative analgesia [6]. Hence, the present study was undertaken to compare the postoperative analgesic efficacy of bupivacaine 0.125%1ml/kg versus bupivacaine 0.125% 1ml/kg and fentanyl 1 µg/kg for caudal anaesthesia in paediatric patients undergoing short surgical procedures.

## Methodology

Sixty children in the age group 1-6 years posted for routine paediatric short surgical procedures below the umbilicus were included. The data was collected in the prepared proforma consisting of age, sex, etc. meeting the objectives of the study.

*Inclusion Criteria*

a. Children aged 1 to 6 years of age
b. ASA physical status 1, posted for routine paediatric short surgeries, below umbilicus

*Exclusion Criteria*

a. Children less than 1 year of age
b. Children with co-existing medical illness
c. Children with coagulation disorders
d. Children with anatomical abnormalities of the spine
e. Children with other metabolic and endocrine disorders
f. Infection at the local site
g. Children with known allergy to local anaesthetics
h. Children with anticipated difficult intubation

The 60 children were randomly divided into two groups of 30 each. Group I received 1ml/kg of 0.125% bupivacaine and Group II received 1ml/kg of 0.125% bupivacaine plus fentanyl 1µg/kg for caudal block.

After securing iv access with appropriate sized iv canula, all children were premedicated with inj. atropine 0.02 mg/kg (minimum 0.15 mg) before induction. Preoperative HR, BP, $SpO_2$ and RR were recorded using routine monitors. After preoxygenation with 100% $O_2$ for 3 min, anesthesia was induced with inj. Thiopentone 5 mg/kg iv and tracheal intubation (with appropriate sized ET tube) was facilitated by inj. succinylcholine 1.5 mg/kg iv followed by IPPV. Anaesthesia was maintained with Halothane with $N_2O$ and oxygen . Inj. vecuronium 0.05 mg/kg was given for maintenance of neuromuscular blockade. IPPV was continued with Jackson Ree's modification of Ayre's t-piece. Intravenous fluid administration was done using Holliday and Segar formula. After this, all children were administered caudal block in the right lateral position, before the start of surgery, using Bupivacaine 0.125%: using bupivacaine 0.25%, half of the required volume was taken and diluted with normal saline in 1:1 dilution, to constitute 0.125% bupivacaine. Fentanyl citrate 1mcg/kg: 0.8ml containing 40mcg of fentanyl was taken in an insulin syringe which has 40 graduations and diluted to 1 ml with normal saline, so that each graduation measured 1 mcg of fentanyl. Study solution was prepared and kept ready before induction depending on the group to which they were assigned. Time of completion of caudal administration of injection was noted down.

Patient was then turned to supine position. Intraoperative monitoring continued with $SPO_2$, NIBP, HR recording every 5 min. Bradycardia and hypotension, if any, were noted and treated appropriately. No supplemental analgesics were given in the intraoperative period. At the end of surgery, neuromuscular blockade was reversed with inj. neostigmine 0.05 mg/kg and inj. atropine 0.02 mg/kg. Extubation was done when reflexes were active. Recovery time, i.e. time taken from administration of reversal agent to extubation was noted down. These two groups were assessed in the post-operative room for sedation,motor blockade, postoperative pain, every 15 min for first hour, then hourly for 6 hours. HR(heart rate), blood pressure, RR(respiratory rate), $SpO_2$ (oxygen saturation ) were also recorded. After 6 hours, the children were observed and monitored 6th hourly for 24 hours using the same parameters.Total duration of analgesia was taken as the time from completion of caudal administration of injection to administration of rescue analgesic. Total number of rescue analgesics received in 24 hours was also noted. Any side effects like postoperative nausea vomiting, pruritus, urinary retention, and respiratory depression (respiratory rate less than 10 or $SpO_2$<90%) were recorded.

*These Two Groups were Compared with Respect to*

1. Duration and efficacy of postoperative analgesia
2. Degree of motor block, if any

3. Incidence and severity of side effects, if any

Statistical analysis of the present study was made by using the following parameters. Percentages ,The arithmetic mean (m or x), The standard deviation (S), t-test & Proportion test The values calculated were compared at 5 percent level of significance (0.05) for the corresponding degrees of freedom. $p < 0.05$ was considered as significant (S) and $p > 0.05$ as not significant (NS).

## Results

Table 1 shows the age distribution of children in both the groups. 40% of children in both the groups were in the age group of 1-3 years and 60% in both the groups were in the age group of 4-6 years. The minimum and maximum age was 1.5 years and 6 years, respectively in both the groups. Age distribution was comparable in both the groups. Mean age in both groups I and II was 3.8±1.46 years ($p < 0.05$).

Majority of the cases i.e. 96.7% and 93.3% in Group I and Group II, respectively were boys. One case in Group I and 2 cases in Group II were girls. Majority of the children i.e. 66.7% in both groups I and II weighed between 7 and 12 kgs. The minimum weight of children in groups I and II were 8 kgs and 9 kgs, respectively. The maximum weight of children in both the groups was 18 kgs. The mean weight in group I was 12 ± 2.88 kgs and in group II it was 12.5±2.89 kgs. There was no significant difference in the weight of the children between groups I and II ($p < 0.05$).

**Table 1:** Age distribution of the cases

| Age (years) | Group I | | Group II | |
|---|---|---|---|---|
| | Cases | % | Cases | % |
| 1-3 | 12 | 40 | 12 | 40 |
| 4-6 | 18 | 60 | 18 | 60 |
| Total | 30 | 100 | 30 | 100 |
| Mean ± SD | | 3.8 ± 1.46 | | 3.8 ± 1.46 |

**Table 2:** Total duration of analgesia (from caudal block to administration of rescue analgesic)

| Duration of Analgesia (minutes) | Group I | | Group II | |
|---|---|---|---|---|
| | Cases | % | Cases | % |
| 240-299 | 7 | 23.3 | 0 | 0 |
| 300-359 | 17 | 56.7 | 4 | 13.3 |
| 360-419 | 2 | 6.7 | 18 | 60.0 |
| 420-479 | 1 | 3.3 | 6 | 20.0 |
| 480-539 | 3 | 10.0 | 2 | 6.7 |
| Total | 30 | 100 | 30 | 100 |
| Mean ± SD | | 341.5 ± 68.23 | | 401.5 ± 44.89 |

**Table 3:** Total rescue analgesics in 24 hours

| Number of rescue analgesics | Group I | | Group II | | p-value |
|---|---|---|---|---|---|
| | Cases | % | Cases | % | |
| < 2 times | 21 | 70 | 29 | 96.7 | < 0.05 |
| > 2 times | 9 | 30 | 1 | 3.3 | < 0.05 |
| Total | 30 | 100 | 30 | 100 | |

Table 2 shows total duration of analgesia. In majority of children in group I, i.e. 17 children (56.7%), the total duration of analgesia lasted between 300 and 359 minutes, whereas in majority of children in group II, i.e. 18 children (60%), the total duration of analgesia lasted between 360 and 419 minutes.

In group I, total duration of analgesia lasted between 240 and 299 minutes in 7 children (23.3%), between 360 and 419 minutes in 2 children (6.7%), between 420 and 479 minutes in 1 child (3.3%), and between 480 and 539 minutes in 3 children (10%).

Whereas, in group II, total duration of analgesia lasted between 300 and 359 minutes in 4 children (13.3%), between 420 and 479 minutes in 6 children (20%), between 480 and 539 minutes in 2 children (6.7%). No child in group II, received rescue analgesic before 300 minutes i.e. minimum total duration of analgesia was 300 minutes, whereas the minimum total duration of analgesia was 240 minutes in group I.

The maximum total duration of analgesia noted in both groups I and II was 510 minutes. Mean total duration of analgesia was 341.5±68.23 min in group I, whereas it was 401.5±44.8 min in group II. The mean total duration of analgesia was more in group II, than in group I, which was statistically significant ($p < 0.05$).

Table 3 shows total rescue analgesics received in 24 hours. Twenty-nine children i.e. 96.7% in group II and 21 children i.e. 70% in group I received rescue analgesics for less than 2 times in 24 hours. Whereas, 1 child i.e. 3.3% in group II and 9 children i.e. 30% in group I received more than 2 times, the rescue analgesic in 24 hours. The difference between the two groups was statistically significant. No side effects like nausea and vomiting, pruritus, motor blockade, urinary retention, respiratory depression was observed in any child in both the groups. In group II children, the mean pulse rate was less than children in group I at all times, which was statistically significant. No bradycardia was observed at any time.

## Discussion

Caudal epidural anaesthesia has become widely accepted as a means of providing postoperative pain relief and intraoperative supplementation to general anaesthesia in children [7]. This simple technique also allows rapid recovery from anaesthesia [8]. It has also been shown that pre but not post surgical caudal block attenuates the stress response associated with lower abdominal surgery [9]. Postoperative analgesia can be provided by single shot caudal block or by placement of an extradural catheter in the caudal space. However placement of an extra dural catheter is time consuming and more expensive than single shot caudal block and may be associated with various technical problems such as difficulty in insertion, vascular damage and leaks [8]. The main disadvantage of this safe and reliable technique of single shot caudal block is its short duration of action. To overcome these problems, various drugs have been added to local anaesthetic solutions to prolong the duration of analgesia provided by a single injection [11]. The duration of analgesia provided by local anaesthetics can be prolonged by addition of opioids. Addition of morphine to caudal bupivacaine has been found to improve both the quality and duration of analgesia for children undergoing orchiopexy [12]. However, respiratory depression has followed a caudal injection of morphine in a child [13]. Fentanyl has been suggested as the opioid least likely to causerespiratory depression when given extradurally, because of its high lipid solubility

The mean duration of surgery in Group I was 8.33±4.10 minutes, and in Group II it was 8.33±5.77 minutes, which constituted the short surgical procedures. This in contrast to other studies where the duration of surgery varied from 40 minutes to two hours [8,10,11,14].

In our study, the mean duration of anaesthesia was 26.1 ±7.52 minutes in Group I, whereas it was 21.1±4.82 minutes in Group II. The difference in duration was statistically significant, although clinically not significantThe mean total duration of analgesia i.e.taken as the time from caudal block to administration of rescue analgesic was 341.5±68.23 minutes in Group I, whereas it was 401.5±44.89 in Group II. The difference in duration was statistically significant ($p<0.05$). These findings concurs with the study conducted by Yeddanapudi et al. [15], who have shown that addition of 1µg/kg but not 0.5 µg/kg of fentanyl to caudal bupivacaine(0.25%) prolonged the postoperative analgesia in children undergoing genitourinary surgery and herniotomy. The duration of postoperative analgesia was significantly longer in bupivacaine plus fentanyl group (324±134 minutes) than in bupivacaine alone group (182±41) in that study. Our study also concurs with the study conducted by Constant et al.8 who found that the duration of analgesia was significantly longer in children receiving caudal fentanyl 1µg/kg to 1ml/kg of a mixture of 0.25% bupivacaine and 1% lidocaine (254min) in equal parts, than those receiving only a mixture of bupivacaine and lidocaine.(164 min)

The above studies using 0.25% bupivacaine with or without fentanyl have yielded a duration of analgesia in the range of 164 minutes to 324 minutes [8,10,11].

However in our present study, the mean duration of analgesia with the use of 0.125% bupivacaine alone was 275.5±44.77 minutes (time from completion of caudal administration of injection to first complaint of pain) and mean total duration of analgesia was 341.5±68.23 minutes (time from completion of caudal administration of injection to administration of rescue analgesic). This longer duration of analgesia can be probably explained by the fact that the mean duration of surgery was very less (8.33 minutes) in comparison to other studies and the minimum tissue damage involved in these short surgical procedures. Various studies report contradicting results in this regard. This may be due

to difficulty in assessing pain in children, especially infants by parents, using the available methods, and these methods are not widely or commonly accepted.

*Total Number of Rescue Analgesics*

In our study, the children in Group I received more rescue analgesics than in Group II. 9 children i.e. 30% in Group I received rescue analgesics > 2 times, in 24 hours, whereas in Group II, only 1 child i.e. 3.3% received rescue analgesics > 2 times, in 24 hours, the difference between the two groups was statistically significant.($p<0.05$) This in contrast to study conducted by Campbell et al [14] where there was no difference in the number of rescue analgesics received by children receiving either bupivacaine 0.125% 1ml/kg or those receiving bupivacaine 0.125% 1ml/kg plus fentanyl 1 µg/kg for caudal block. In our study no bradycardia or hypotension was observed at any time. This is similar to study by Constant et al [8] who found no incidences of haemodynamic instability in their study. No side effects like nausea and vomiting, pruritus, urinary retention, respiratory depression were noted in any child in both the groups. This is in contrast to study conducted by Campbell et al [14] where vomiting, shivering, pruritus was observed in nearly 40% children receiving bupivacaine and bupivacaine plus fentanyl. However the difference in side effects between the two groups was not statistically significant in their study. Respiratory depression was defined as respiratory rate less than 10 or oxygen saturation < 90%. This concurs with the study conducted by Sibel Baris et al [11] where there were no incidence of respiratory depression with the use of fentanyl 1µg/kg for caudal block. These findings are also similar to study by Campbell et al [14] who found no incidence of respiratory depression with the use of caudal fentanyl.

## Conclusion

Single shot caudal epidural block using 0.125% bupivacaine 1 ml/kg (Group I) and 0.125% bupivacaine 1 ml/kg plus fentanyl 1µg/kg(Group II), after induction of general anaesthesia, but before surgery was effective for postoperative analgesia in children undergoing short surgical procedures. The total duration of postoperative analgesia was significantly longer in children receiving 0.125% bupivacaine 1ml/kg plus fentanyl 1µg/kg (401.5±44.89 minutes) than in children receiving 0.125% bupivacaine 1ml/kg alone. (341.5±68.23 minutes). Group II children received less number of rescue analgesics than children in Group I in 24 hours period (postoperative). Haemodynamic stability was maintained in children of both the groups. Side effects like nausea and vomiting, pruritus, urinary retention, respiratory depression, were not observed in any child in both the groups.

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