

## POSTOPERATIVE ANALGESIA IN PAEDIATRICS PATIENTS THROUGH CAUDAL BLOCK WITH BUPIVACAINE AND TWO DIFFERENT DOSES OF FENTANYL - A COMPARATIVE STUDY.

Ranjita Acharya<sup>1</sup>, Saubhagya Kumar Jena<sup>2</sup>, Soumya Samal<sup>3</sup>, Suvendu Narayan Mishra<sup>4</sup>

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**ABSTRACT: BACKGROUND:** Narcotics have been used through caudal epidural route to supplement the effects of local anesthetics. **MATERIALS & METHODS:** This prospective, comparative study was carried out in a medical college and hospital after taking approval from institutional ethical committee. Ninety paediatric cases between 2 to 7 years of age, with ASA grade I & II posted for infra-umbilical surgeries were selected for the study. They were randomly divided into three groups out of which group I received Injection Bupivacaine (0.25%) 2mg/kg with normal saline, group II bupivacaine (0.25%) 2mg/kg with fentanyl 0.5mcg/kg and group III bupivacaine (0.25%) 2mg/kg with fentanyl 1mcg/kg caudally. The outcome measures were changes in haemodynamic parameters, duration of postoperative analgesia, mean pain score and occurrence of any adverse effects. **RESULTS:** The demographic profile was similar in all three groups. The preoperative, intra-operative and postoperative haemodynamic parameters were similar in three groups. The duration of postoperative analgesia was significantly longer in group III ( $9.11 \pm 0.62$  hours) as compared to group II ( $7.1 \pm 0.66$  hours) and group I ( $3.26 \pm 0.59$  hours). Similarly the mean pain score was significantly more in group I as compared to group II and group III. The incidences of adverse effects were similar among all three groups. **CONCLUSION:** Caudal fentanyl with bupivacaine provides prolonged and good quality postoperative analgesia as compared to plain bupivacaine in children undergoing infra-umbilical surgeries. However, fentanyl at dose of  $1 \mu\text{g kg}^{-1}$  produces longer postoperative analgesia as compared to the dose of  $0.5 \mu\text{g kg}^{-1}$  without any adverse effects.

**KEY WORDS:** Bupivacaine: Caudal anesthesia: Fentanyl: Postoperative analgesia.

**INTRODUCTION:** Postoperative pain is an acute category of non malignant pain. Though pain may be protective, defensive or diagnostic; it produces or precipitates many psychological and systemic side effects. Postoperative pain treatment in children is often insufficient and less potent analgesics are used as compared with adults. <sup>(1)</sup> Any method of postoperative analgesia must meet three basic criteria. It must be effective, safe, and predictable. There are different methods to approach the postoperative pain relief in paediatric patients that include drugs which can be administered intravenously, intramuscularly, rectally and other methods are regional anesthesia, play, music and art therapy. <sup>(2)</sup>

Regional anesthesia produces profound intra as well as postoperative analgesia with minimal physiological alteration. <sup>(3)</sup> It hastens awakening, permits early ambulation, shortens recovery room stay and produces pain free postoperative period. Postoperative analgesia through the caudal route is considered to be the most appropriate and satisfactory analgesia for small children undergoing anoperineal, inguinal and urogenital surgery. <sup>(4,5)</sup>

Caudal block is notable for its simplicity, safety and effectiveness. It is a common practice to have a single shot caudal block with local anaesthetic agent like bupivacaine which provides analgesia during surgery but its action terminates early in the postoperative period. Various drugs have been added to local anaesthetics to prolong the postoperative analgesia like opioids, clonidine, ketamine, midazolam etc. <sup>(6)</sup> Fentanyl has been suggested as the opioid least likely to cause respiratory depression. <sup>(7)</sup> When given extradural, because of its high lipid solubility so that it does not tend to spread rostrally in cerebrospinal fluid (CSF) and move rapidly from CSF into the spinal cord. Most of previous studies have used different doses of fentanyl for caudal block, but there are limited number of studies comparing bupivacaine and different doses of fentanyl. Also, there is a need to identify the optimal dose of fentanyl for use as an adjuvant to local anesthetic for caudal blockade.

The present study was carried out to compare between plain bupivacaine and combination of two different doses of fentanyl for caudal block among paediatric patients.

**MATERIALS AND METHODS:** This prospective, randomized, double blind comparative study was carried out in a medical college and hospital during 2008 to 2009 after taking approval from the institutional ethical committee. Total 90 paediatric patients of ASA grade I and II, between 2 to 7 years of age and both sex were selected for the study. Patients with the history of allergic reaction to local anaesthetics or any other drugs, bleeding diathesis, preexisting neurological disease, local sepsis and grossly abnormal sacral anatomy were excluded from the study. Informed parental consent was taken for all subjects participating in this study.

Patients were received on pre-anesthetic check up on the previous day of surgery. Detailed history was taken, thorough physical examination was done and investigation was checked. Patients were fasted for 6hrs for solid food and clear fluid for 3hrs before the procedure. They were pre-medicated with injection glycopyrrolate 10mcg/kg, 45min before the surgery. Preoperatively their vitals were checked. EMLA cream was applied with occlusive dressing one hour before the operation on selected site for securing intravenous line. After cannulation of dorsal hand vein with a suitable gauge cannula, anesthesia was induced with injection ketamine 1-2mg/kg body weight intravenously, a laryngeal mask airway (LMA) was inserted and patients were maintained on spontaneous breathing through LMA with halothane 1% and nitrous oxide 60% in oxygen. No analgesic was administered before or during surgery. After induction of general anesthesia, patients were randomly assigned to one of the three groups comprising of thirty patients each. Caudal block was given with bupivacaine and/or fentanyl of the following composition:

Group I- bupivacaine (0.25%) with normal saline.

Group II- bupivacaine (0.25%) with fentanyl 0.5mcg/kg.

Group III- bupivacaine 0.25%) with fentanyl 1mcg/kg.

Total volume of drug was made up to 1ml/kg after diluting the drug with saline.

The drug to be administered was prepared by a second anesthesiologist otherwise uninvolved in the study. The anesthesiologist performing the block and assessment was blinded to the drug administered. After induction of anesthesia and before surgery, patients were placed in the left lateral position for caudal block which was performed using aseptic technique. Caudal block was performed with 22 gauge needle and space was confirmed by whoosh test. Then the allocated dose

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of the drug was injected according to group-I, group-II, and group-III. After completion of the block the child was turned to supine position. Effectiveness of the block was assessed by haemodynamic stability and decreased requirement for inhalational anaesthetics. Block was considered adequate when there was no increase in respiratory rate, heart rate and systolic blood pressure by 15%, just after surgical incision compared to pre-operative values. All patients were monitored haemodynamically throughout the procedure at regular intervals of 5 minutes. At the end of surgery when patient was recovered fully, laryngeal mask airway was removed and patient was shifted to the recovery room. Duration of analgesia was taken as time between caudal block and first administration of rescue analgesia. Assessment of pain was done in the postoperative period using Hannallahs pediatric objective pain score (OPS). Paracetamol ( $5\text{mg kg}^{-1}$ ) intravenously was given when the OPS was 4 or more. During the postoperative period complications like nausea, vomiting, pruritus, respiratory depression and urinary retention etc were noted. Statistical analysis was done by using chi-square test, T- test and ANOVA test.

**RESULTS:** The age, sex, weight and duration of surgery were similar between the three groups (Table 1). The type of lower abdominal surgery was comparable in between the three groups. There was no significant difference between preoperative, intra-operative and immediate post operative heart rate, systolic blood pressure (SBP) and respiratory rate in the three groups (Table 2). The mean pain score in group I showed a progressive upward trend over the first 4 postoperative hours while in group II it was within 6-8hrs and 8-10hrs in group III (Table 3). Pain scores were not recorded after supplemental analgesia. The mean time to first analgesia (hours) was significantly shorter in group I ( $3.26 \pm 0.59$ ) compared to that in group II ( $7.1 \pm 0.66$ ), group III ( $9.11 \pm 0.62$ ) [Fig.1]. ANOVA with post-hoc analysis revealed that  $p < 0.0001$  in comparison between any two drug groups. Thus the mean duration of analgesia was significantly different in all three groups, and was maximum in group III. Complications like nausea and vomiting observed in 15%, 20% and 25% of patients in group I, II and III respectively but it was not significant statistically ( $p > 0.05$ ).

Character	GROUP I (n=30)	GROUP II (n=30)	GROUP III (n=30)	'P' Value
Age in years (Mean $\pm$ S.D)	$4.45 \pm 1.62$	$4.5 \pm 1.63$	$4.5 \pm 1.63$	0.9327
Sex				
Male (%)	83.3%	90%	86.6%	0.456
Female (%)	16.7%	10%	13.4%	
Weight in kg (Mean $\pm$ S.D)	$15.55 \pm 6.03$	$13.05 \pm 5.85$	$13.95 \pm 6.09$	0.4047
Duration of surgery in minutes (Mean $\pm$ S.D)	$60.2 \pm 3.51$	$60.1 \pm 3.61$	$60.05 \pm 2.32$	0.9778

Table -1: Demographic Profile

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Time Interval	GR-I			GR-II			GR-III		
	HR (mins)	SBP (mmHg)	RR (mins)	HR (mins)	BP (mmHg)	RR (mins)	HR (mins)	BP (mmHg)	RR (mins)
pT	107.3 ± 1.83	104.75 ± 1.971	18.75 ± 1.51	107.2 ± 1.57	103.9 ± 1.489	17.65 ± 1.38	107.8 ± 1.79	105 ± 1.77	17.9 ± 1.77
T5	107.65 ± 2.05	105.1 ± 2.15	18.05 ± 1.76	107.35 ± 1.56	104.55 ± 1.35	18.1 ± 1.55	107.55 ± 1.8	104.85 ± 1.63	17.95 ± 1.7
T15	107.6 ± 1.789	104.95 ± 1.79	17.95 ± 1.76	106.95 ± 1.57	104.10 ± 1.68	17.5 ± 1.70	106.95 ± 1.82	105.35 ± 1.59	17.8 ± 1.47
T30	108.2 ± 2.44	104.8 ± 1.47	17.85 ± 2.32	107.5 ± 1.433	104.0 ± 1.45	18.35 ± 1.95	107.65 ± 2.346	105.15 ± 1.72	18.05 ± 1.87
T45	107.45 ± 1.959	104.9 ± 1.94	18.2 ± 2.11	108.05 ± 1.669	104.15 ± 1.46	17.35 ± 1.95	107.2 ± 1.576	105.5 ± 1.75	17.6 ± 1.42
T60	106.85 ± 1.755	104.9 ± 1.58	17.75 ± 1.25	107.5 ± 1.96	104.0 ± 1.58	17.55 ± 1.73	107.3 ± 1.68	104.8 ± 1.08	18.2 ± 1.32
Imm. postop	106.75 ± 1.86	104.4 ± 1.79	18.1 ± 1.99	107.4 ± 1.465	104.05 ± 1.66	17.95 ± 1.43	107.5 ± 2.306	105.2 ± 1.96	18.3 ± 1.45

Table -2: Peri-operative Hemodynamic Parameters

Data expressed in Mean ± S.D

Group	Hours after operation									
	Imm	2hr	4hr	6hr	8hr	10hr	12hr	16hr	20hr	24hr
I	0.2 ± 0.5	2.84 ± 0.77	4.74 ± 0.60							
II	0±0	0.29 ± 0.39	1.64 ± 0.85	3.48 ± 0.94	4.7 ± 0.69					
III	0±0	0	0.19 ± 0.26	1.36 ± 0.67	3.17 ± 0.76	4.63 ± 0.62				

Table - 3: Mean Pain Score

Data expressed in Mean ± S.D

## DURATION OF POSTOPERATIVE ANALGESIA

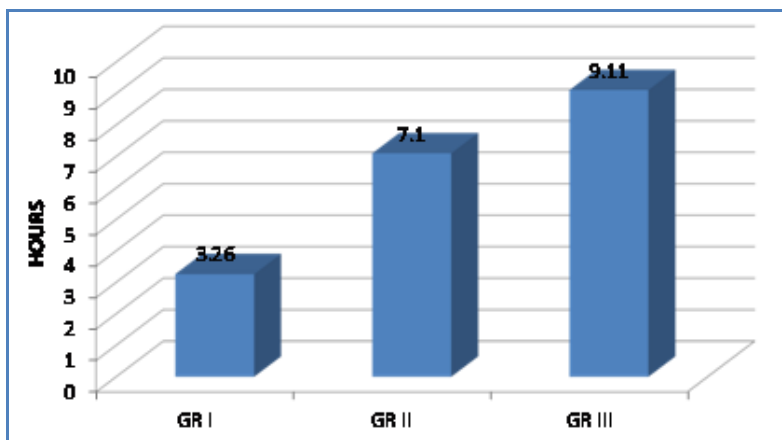


Figure 1: Bar diagram showing the duration of postoperative analgesia in three groups.

**DISCUSSION:** Postoperative pain may result in psychological, physiological, neuroendocrine, respiratory, cardiovascular problems ultimately increasing the risk of postoperative complications. This remains one of the most important and pressing issues in the field of anaesthesia.

Paediatric surgical patients pose some unique problems as compared to adults. They definitely perceive pain, it is only their inability to express this perception that leads to the belief that do not do so. Since a long time, there is a common debate about choice of anaesthesia for lower abdominal surgeries in paediatric age group. Regional anaesthesia in the form of caudal anaesthesia is a very popular technique for providing anesthesia and postoperative analgesia in paediatric patients as it is simple to perform, more reliability and predictability of the cephalad spread of local anaesthetic solution in children than in adults, has minimal haemodynamic changes and provide some pain free postoperative period.

Caudal injection of bupivacaine is commonly used to provide anaesthesia for lower abdominal and lower limb surgeries in children, however its analgesic effect terminates early and supplementary analgesics are required in postoperative period. Fentanyl is a synthetic opioid agonist. It exerts its analgesic action by binding to mu receptor and also binds to kappa and delta receptor within the spinal cord, producing spinal analgesia.

In this present study we compared plain bupivacaine with two different doses of fentanyl for caudal block in paediatric patients. The three groups are comparable in demographic profile. There were no significant change in pre, intra and postoperative haemodynamic parameters in each group. Other studies also showed similar findings. Study by Desai et al in comparing bupivacaine 0.25% with two different doses of fentanyl (1mcg/kg and 0.5mcg/kg) with adrenaline found that there was no significant differences in haemodynamic and respiratory parameters in between two groups. <sup>(6)</sup> Gharshallah A et al compared two different doses of fentanyl 0.5mcg/kg and 1mcg/kg with 0.25% bupivacaine in paediatric age group. They also found no significant changes in haemodynamic parameters as well as respiratory changes. <sup>(8)</sup> Campbell et al also found haemodynamic stability in their study of single caudal injection of 0.125% bupivacaine with fentanyl (1mcg/kg). <sup>(9)</sup>

However, there were no reported studies comparing plain bupivacaine and different doses of fentanyl.

Unlike morphine, fentanyl easily crosses the lumbar dura and penetrates quickly the lipid phase of underlying tissue of the cord with minimal migration of opioids in rostral direction hence avoiding CNS depression of respiratory and cardiovascular system.

The duration of postoperative analgesia was significantly longer in group III as compared to group II and group I. The OPS score too showed a complimentary trend with group III showing upward trend only after 8 hours. Other studies in this regard also showed similar findings. Desai et al found out in their study that the duration of analgesia was  $5.04 \pm 0.35$  hrs in group I (1mcg/kg fentanyl) and  $3.30 \pm 0.57$  hrs in group II (0.5mcg/kg fentanyl) which shows that duration of analgesia was longer in group I than in group II. <sup>(6)</sup> Constant et al studied the effect of fentanyl or clonidine to bupivacaine 0.25% on prolongation of duration of analgesia after single shot caudal block and concluded that it was  $253 \pm 105$  minutes with fentanyl (1mcg/kg) whereas it was  $287 \pm 130$  minutes in group fentanyl (0.5mcg/kg) with clonidine (0.75mcg/kg) which signified that it was clonidine which has prolonged the analgesic effect of 0.5mcg/kg of fentanyl. <sup>(10)</sup> Rucci et al found that, when dose of fentanyl was increased in the mixture there was quick analgesic blockade. <sup>(11)</sup> Moine et al found more than 24hrs of postoperative analgesia in their study of caudal bupivacaine (0.5%) with fentanyl (1mcg/kg). <sup>(12)</sup> Lomessy A et al in their study reported that fentanyl increases both quality and duration of post operative analgesia. <sup>(13)</sup>

However, Campbell et al compared the postoperative analgesia with caudal bupivacaine (0.125%) and fentanyl (1mcg/kg) with bupivacaine alone in their study. <sup>(9)</sup> They concluded that addition of fentanyl neither improved nor prolonged the postoperative analgesia. Similar findings was also reported by Gharsallah et al. <sup>(8)</sup> Whereas, in our study it was found that the duration of analgesia was longer in fentanyl group as compared to bupivacaine alone.

In this study 15% patient in Group-I, 20% patients in group-II and 25% patients in Group-III had nausea and vomiting. Though the incidence of vomiting was more in the patients receiving fentanyl, the results were not statically significant. None of the patients in our study had pruritus, respiratory depression and urinary retention. Other studies in this regard reported similar findings. <sup>(6, 8)</sup>

An opioid analgesic with local anesthetics by caudal route is a safe, effective and reliable method of postoperative pain relief. Fentanyl produces a faster onset of analgesia with fewer side effects like nausea, vomiting. Fentanyl with 1mcg/kg has the advantage of a longer duration of analgesia than fentanyl with 0.5mcg/kg and bupivacaine only.

**CONCLUSION:** Postoperative analgesia in pediatrics cases by caudal block with combination of bupivacaine 0.25% and fentanyl provided satisfactory anaesthesia without any haemodynamic disturbances. The duration of analgesia is significantly prolonged when the dose of fentanyl is increased from 0.5mcg/kg to 1mcg/kg without any major postoperative complications.

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## AUTHORS:

1. Ranjita Acharya
2. Saubhagya Kumar Jena
3. Soumya Samal
4. Suvendu Narayan Mishra

## PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Anaesthesiology, IMS and SUM Hospital, Bhubaneswar, Odisha.
2. Assistant Professor, Department of Obstetrics and Gynaecology, AIIMS, Bhubaneswar, Odisha.
3. Assistant Professor, Department of Anaesthesiology, IMS and SUM Hospital, Bhubaneswar, Odisha.

4. Assistant Professor, Department of Psychiatry, IMS and SUM Hospital, Bhubaneswar, Odisha.

## NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Saubhagya Kumar Jena,  
Assistant Professor,  
Department of Obstetrics and Gynaecology,  
AIIMS, Bhubaneswar,  
At: Sijula, Po: Dumduma,  
Bhubaneswar, Odisha, Pin: 751019.  
Email- drsaubhagya@gmail.com

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