



## A Comparative Study of Clonidine Versus Fentanyl as an Adjuvant for Caudal Block in Children

### KEYWORDS

Caudal analgesia, adjuvants ,pediatric patients

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**ABSTRACT** Caudal epidural block is a versatile and simple technique; but offers relatively short duration of postoperative analgesia (4-6 hrs) even with the use of long acting local anaesthetics like Bupivacaine. To improve the duration of action and quality of analgesia various additives have been used to caudal Bupivacaine. The aim of the present study was to compare effect of addition of Fentanyl or Clonidine to Bupivacaine in terms of postoperative duration of analgesia and quality of intraoperative anaesthesia.

In a prospective, double-blinded, randomized controlled trial 90 children aged 1-10 years posted for elective infra umbilical surgery were randomly allocated to receive caudal Bupivacaine 0.25% 1ml/kg alone (Group B) , or addition of Fentanyl 1µgm/kg (Group BF) or Clonidine 1µgm/kg (Group BC) caudally to Bupivacaine 0.25% 1ml/kg. In addition to routine monitoring intra operatively, patients were postoperatively observed for FLACC pain score and sedation scores. Significant pain relief was observed in Group B upto 4 hours (FLACC- 4.14±1.16), in group BF upto 6 hours (FLACC- 3.71±1.22) and Group BC upto 9 hours (FLACC- 3.86±0.78). The overall haemodynamic stability was better in Group BF as compared to Group BC and group B. Thus, to conclude addition of Clonidine or Fentanyl to Bupivacaine significantly improve duration of caudal block. Also Fentanyl helps in early initiation of caudal block.

### Introduction:-

The Society of Paediatrics on its 15<sup>th</sup> annual meeting at New Orleans, Louisiana (2001) clearly defined the alleviation of pain as a "basic human right," irrespective of age, medical condition, treatment, primary service response for the patient care or medical institution.<sup>1</sup> Finely et al (1996) observed that many types of so called minor surgeries (e.g. Circumcision) can also cause significant pain in children.<sup>2</sup> The goal of postoperative pain relief is to reduce or eliminate pain with minimum side effects and be economic too. Effective pain relief leads to a smooth postoperative period, increased patient compliance and an early discharge from the hospital.<sup>3</sup> Although, Caudal block is a relatively simple technique with a predictable level of blockade one of the major limitations of the single shot injection technique is the relatively short duration of postoperative analgesia (4-6 hrs) even with the use of long acting local anaesthetics like Bupivacaine. A survey by Sanders in 2002 reported that use of adjuncts like Ketamine, Clonidine, Fentanyl and Diamorphine is very popular to a single shot caudal block<sup>4</sup>.

Epidural Fentanyl is commonly added to local anaesthetics and is found to be safe and effective with least likelihood of causing respiratory depression in the paediatric population. Clonidine an alpha 2 adrenergic agonist produces analgesia without significant respiratory depression after systemic, epidural or intrathecal administration. It is devoid of opioid side effects but may produce excessive sedation, hypotension and bradycardia in children.<sup>5</sup>

We therefore, designed a prospective randomized control trial to assess efficacy in respect of intraoperative quality of anaesthesia, the postoperative analgesia and side effects, if any, of Caudal Bupivacaine plus Clonidine or Fentanyl.

### Material and Methods -

After Institutional Ethical Committee clearance and proper informed consent from the parents 105 children of either

sex, aged 1 to 10 years, coming for various elective infra umbilical surgical procedures and minor lower extremity procedures were included in the present study. Patients with infection at the site of injection, Congenital deformities of the Spine, Suspected Coagulopathy or bleeding disorder, active Neurological disease, any active respiratory tract infection, allergy to any of the study drugs being used or history of asthma, Weight more than 20 kg and where parents refused to give consent were excluded from the study. Proper NBM instructions given to parents.

All the patients were premedicated with Injection Glycopyrrolate 5µgm/kg plus injection Ketamine 5 mg/kg intramuscularly 15-20 minutes prior to surgery. Vital parameters like Heart rate, Blood pressure, respiratory rate and SpO<sub>2</sub> were noted before and after premedication. IV line was established once the patient was quiet. In the operating room monitors were attached to record vital parameters.

Ensuring adequacy of vital parameters and achieving sufficient deep plain of anaesthesia on facemask, lateral position was given. Under all aseptic precautions, caudal block was achieved using 23 G 1.5 inch hypodermic needle. Study drug was injected once aspiration test was negative. (figure 1&2 )

Patients were randomly allocated to one of the three groups as described below and received the drugs based on Armitage formula<sup>6</sup> to achieve thoracolumbar block.

**Group B** patients received Bupivacaine 0.25%, 1ml/kg caudally.

**Group BC** patients received Bupivacaine 0.25%, 1ml/kg plus Inj. Clonidine 1µgm/kg caudally.

**Group BF** patients received Bupivacaine 0.25%, 1ml/kg plus Inj. Fentanyl 1µgm/kg caudally.

Maximum volume of dose was fixed at 20ml.

Surgery commenced after 10 minutes of performing caudal block. Airway management was left at the discretion of the in charge anaesthesiologist and duration of surgery. Anaesthesia was maintained either via facemask, LTS, LMA or ETT on O<sub>2</sub> + N<sub>2</sub>O + Sevoflurane.

The dial concentration of Sevoflurane requirement was also noted at regular intervals. After caudal block, concentration of Sevoflurane was used just to keep the patient in the plain of anaesthesia to be immobilised or sufficient to tolerate the airway gadget being used.

Patients were monitored for heart rate, respiratory rate and blood pressure after administration of caudal block at 0,2,5,10,15,20,25,30,35 minutes and the values were recorded. Postoperatively values were noted at 0,10,30, 1 hour and then every hour thereafter for above parameters plus pain sale (FLACC) and sedation score. Adequacy of block was judged by haemodynamic stability.

Persistent ≥15% increase than baseline of heart rate, SBP and RR at surgical incision and thereafter suggested inadequate block.

Failed block was defined when it was necessary to increase the concentration of the inhaled anaesthetics, in response to a 20% increase for more than 5 minutes of the systolic pressure and/or heart rate from the baseline values. Such patients were excluded from the study.

At the end of surgery, once the vitals were stable and on awakening child was shifted and placed in lateral recovery position. Duration of analgesia was defined as the time interval between the administration of Caudal block and the first requirement of rescue analgesia for the patient. Post-operative analgesia was assessed by FLACC scale. If the pain score was ≥4 for 2 consecutive intervals of 10 minute then rescue analgesia with either IV Pentazocine 0.3mg/kg or Paracetamol suppository 15mg/kg was given to achieve FLACC score ≤3. The need for rescue medication was considered as the end point of the study and the data obtained from those children were no longer considered.

**FLACC score:-<sup>7</sup>**

Categories	SCORING		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown; withdrawn, disinterested	Frequent to constant frown, clenched jaw, quivering chin
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 or sobs; frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging, Difficult to console or comfort or being talked to; distractable	Difficult to console or comfort

Each category is scored on the 0–2 scale, which results in

a total score of 0–10.

**0** - Relaxed and comfortable **4–6** - Moderate pain

**1–3** - Mild discomfort **7–10** - Severe discomfort or pain or both

**Sedation score:-<sup>8</sup>**

As the study drugs like Clonidine, Fentanyl may cause sedation, sedation score was also noted:-

1. Alert awake
2. Asleep arousable by verbal contact
3. Asleep arousable by physical contact
4. Asleep, not arousable.

**Statistical Analysis:-**

Statistical analysis was done by using Descriptive Statistics and Inferential Statistics, using Chi square test and One Way Analysis of Variance (ANOVA). The statistical software used in the analysis was SPSS 17.0 version and Graph pad Prism 5.0 Version.

The results were tested at 5% level of significance.

Post hoc comparison done with Tukey's multiple comparison test

**Results:-**

Patients in all the three groups were comparable in respect of age, weight and mean duration of study. Male preponderance was seen in all the study groups.

The baseline pulse rate, SBP, DBP and RR was also comparable in all the three groups. **(Table-1)**

Intraoperatively slight rise in Pulse rate was noted in Group B, BF, but significant fall in group BC (p<0.05). **(Graph-1)**

Post incision there was trend towards fall in SBP in all the study groups. However the fall was maximum in Group BC as compared to Group BF and Group B which was statistically significant both intra op and postop. **(Graph-2)**

Respiratory rate significantly increased and remained higher till about 20 minutes post caudal in group B (p< 0.05).

While in study groups (BC and BF) there was a gradual decline in RR after Caudal and remained stable within normal range. **(Graph-3)**

Mean Sevoflurane dial concentration was comparable in all the study groups just after Caudal. However at 10 minutes i.e. at incision time and thereafter it was lowest in Group BF (p<0.05) as compared to Group BC and Group B, suggesting earlier onset of analgesia in Group BF. **(Graph-4)**

Immediate postop (0 min) significantly higher sedation score was seen in Group BC (3.05±0.23) as compared to Group B (2.85±0.35) and Group BF (2.85±0.49)

When two study Groups (BC v/s BF) were compared better sedation was noted in Group BC till 2 hours postop, while in Group B and Group BF patients were well awake at 1 hour postop. **(Graph-5)**

FLACC score indicative of discomfort and pain was comparable in all the study groups upto 10 minutes postop.

However it started rising, patients in Group B had significant pain at 4 hours ( $4.14 \pm 1.16$ ) while in Group BF experienced pain at almost 6 hours ( $3.71 \pm 1.22$ ). Patients in Group BC had longer pain free interval of approximately 9 hours ( $3.86 \pm 0.78$ ). (Graph-6)

The postop duration of analgesia was highest in Group BC ( $513.17 \pm 39.51$  min.) as compared to Group BF ( $356.37 \pm 28.22$  min.) amongst the study groups, while in Control group i.e. Group B it was lowest ( $248.62 \pm 21.87$  min.) which was statistically significant ( $p$  value  $< 0.05$ ). (Table-2)

Complications like Bronchospasm and Laryngospasm in 2 & 1 patient respectively in Group B at the time of incision was noted and treated appropriately.

In Group BF had minor complications like Nausea(3 patients) and vomiting and urinary retention(2 patients) post-op were noted.

#### Discussion:-

As children were anaesthetized with Inj. Ketamine prior to caudal block it was clinically difficult to assess exact onset of sensory block by standard techniques like pin prick or cold test. Pain evokes negative physiologic, metabolic and behavioural changes even in children including increase in heart rate, respiratory rate, blood pressure. Thus increase in heart rate, SBP and RR in response to surgical stimulus can be used as surrogate markers of pain or inadequate block or analgesia in children<sup>9</sup>. After incision, the inspired concentration of Sevoflurane was adjusted according to the patient's response to surgical stimulus i.e. tachycardia, hypertension, hyperventilation. The dial concentration of Sevoflurane was lower till 10 minutes of surgery in Group BF as compared to Group BC and Group B. ). The overall Sevoflurane requirement was higher in group B than in group BC and BF. Methods of prolonging the duration of Caudal analgesia would clearly be useful, additives is one such technique which can be used to prolong the duration of caudal analgesia<sup>10</sup>.

Addition of Fentanyl to Bupivacaine speeds the onset of sensory block.. Epidural fentanyl most probably acts at both supraspinal (via systemic delivery) and spinal sites, in addition to drug diffusing to spinal receptors from the cerebrospinal fluid. Fentanyl which is highly lipid soluble, enjoys greater direct diffusion into neural tissue and has a relatively rapid uptake into the lipid rich dorsal horn and, consequently has a rapid onset of action.<sup>11</sup>

Clonidine, an alpha 2 adrenoceptor agonist, in the dose  $1-5 \mu\text{g}/\text{kg}$  has analgesic effect which is more prolonged after neuraxial injection, suggesting a spinal site of action and makes this route of administration preferable.<sup>12,13</sup> But higher dose leads to significantly lower systolic pressures and heart rates due to stimulation of alpha 2 inhibitory neurons in the medullary vasomotor centre, during the first 3 hours after surgery<sup>14,15,16</sup>.

Caudal Clonidine does appear to have dose dependent sedative effect.<sup>15</sup> Sedation after epidural clonidine results from activation of alpha 2-adrenoceptors in the locus coeruleus, an important modulator of vigilance.

While self-report of pain should be obtained whenever possible, behavioural observation remains the primary method for pain assessment in children with limited verbal and cognitive skills.<sup>17</sup> The Faces, Legs, Activity, Cry

and Consolability (FLACC) Behavioural Pain Assessment Tool provides a simple and consistent method to identify, document, and evaluate pain in children.<sup>7</sup> The FLACC tool was shown to have good inter rater reliability and excellent validity as demonstrated by changes in pain scores from before to after analgesic administration and excellent correlation with the Objective Pain Scale (OPS) in a study of children aged 2-7 years.<sup>7</sup> The duration of analgesia was significantly prolonged in Group BC ( $513.17 \pm 39.51$  min) as compared to Group BF ( $356.27 \pm 28.22$ ) with intermediate duration and lowest with Group B ( $248.62 \pm 21.87$ ) ( $p$  value  $< 0.05$ ). This may be due to direct stimulation of pre and post synaptic spinal cord by Clonidine and hyperpolarization and decrease in excitability of nerve cell membrane by Fentanyl.

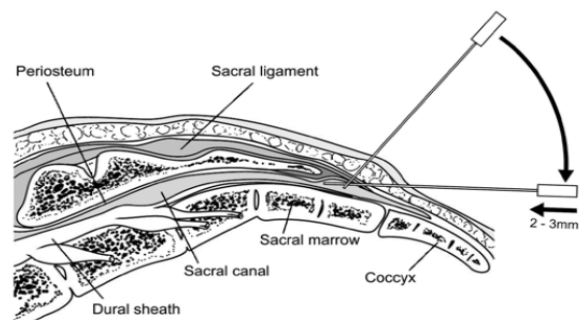
#### Conclusion:-

Addition of Clonidine ( $1 \mu\text{g}/\text{kg}$ ) or Fentanyl ( $1 \mu\text{g}/\text{kg}$ ) to Bupivacaine 0.25% ( $1 \text{ml}/\text{kg}$ ) proved beneficial in respect of prolonged duration of analgesia after a single shot caudal block.

Clonidine is superior in terms of intra op quality of analgesia and duration of postoperative analgesia too, as evident by stable intraoperative haemodynamic variables and reduced Sevoflurane requirement. The immediate postop sedation noted in this group added to the comfort of patients as well as their parents.

Fentanyl helps to early initiation of Sensory block, though the duration of analgesia is more as compared to Bupivacaine alone, but is lesser than Clonidine.

**Figure 1 & 2**  
Puncture - orientation of the needle and reorientation after crossing the sacro-coccygeal ligament.



#### Caudal anaesthesia technique



Table 1-Demographic & Baseline comparison

Parameters	Group B	GroupBC	Group BF	p-value
Age (yrs)	3.76±1.42	3.90±1.48	3.25±1.30	0.13 NS,p>0.05
Gender (M:F)	27:8	28:7	30:5	0.64 NS,p>0.05
Weight (kg)	12.88±3.13	13.45±3.15	12.77±2.23	0.56 NS,p>0.05
Mean Duration of surgery (min)	25.14	26.57	24.85	0.386 NS,p>0.05
Pulse Rate	121.40±12.36	121.37±10.70	125.57±9.28	0.182 NS,p>0.05
SBP	94.74±6.54	94.00±6.31	95.60±6.83	0.596 NS,p>0.05
DBP	55.57±5.36	53.48±6.10	54.94±4.76	0.263NS,p>0.05
RR	23.88±2.90	23.45±2.03	24.02±2.72	0.630 NS,p>0.05

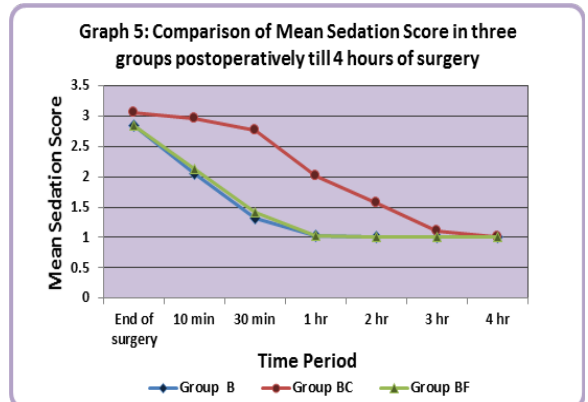
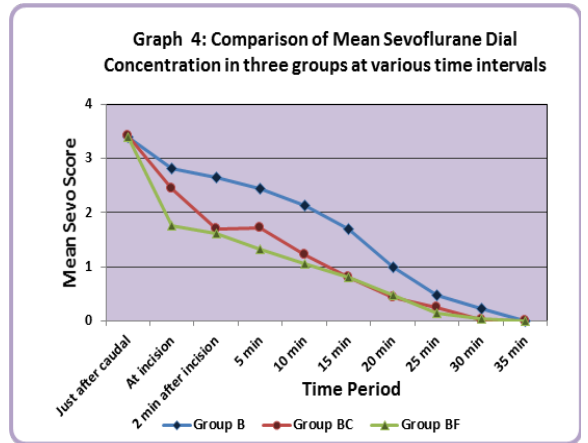
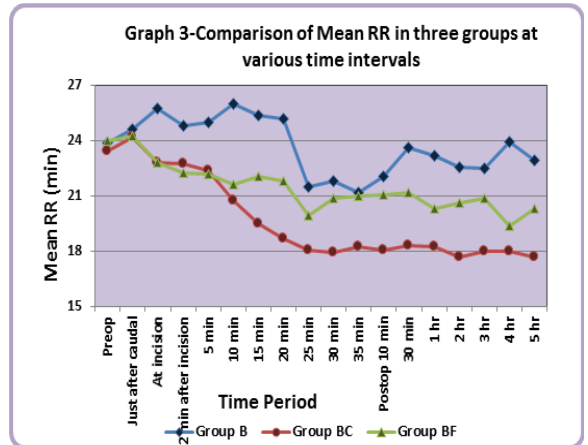
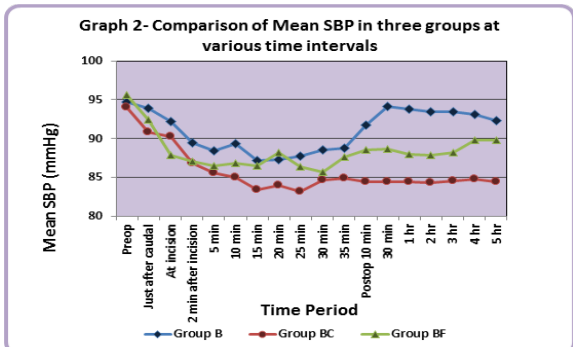
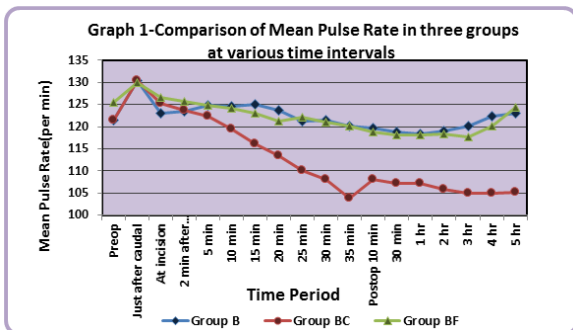
Table No. 2: Comparison of duration of analgesia in three groups

Duration of analgesia (min.)	Group B	GroupBC	Group BF	p-value
Mean	248.62	513.17	356.37	0.000
SD	21.87	39.51	28.22	S,p<0.05

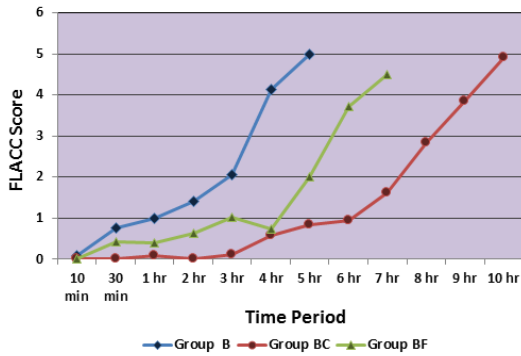
Multiple comparison: Tukey Test

Group	Mean Difference (I-J)	Std. Error	p-value	
Group B	GroupBC	-264.54	7.35	0.000 S,p<0.05
	Group BF	-107.74	7.35	0.000 S,p<0.05
GroupBC	Group BF	156.80	7.35	0.000 S,p<0.05

Graphs showing Haemodynamic Variation



**Graph 6: Comparison of Mean FLACC Score in three groups postoperatively till 10 hrs of surgery**



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