

## A PROSPECTIVE, RANDOMIZED, DOUBLE BLIND, CONTROLLED CLINICAL STUDY OF ADJUVANT EFFECT OF FENTANYL (1 µg/kg) OR CLONIDINE (2µg / kg) TO ROPIVACAINE 0.2% 1ML/KG FOR CAUDAL ANALGESIA IN CHILDREN UNDERGOING LOWER ABDOMINAL SURGERIES

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### HOW TO CITE THIS ARTICLE:

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**ABSTRACT:** Ropivacaine having better safety profile and less motor blockade than bupivacaine is well suited for caudal analgesia. Since studies done regarding the effect of fentanyl and clonidine as adjuvants to ropivacaine for prolongation of caudal analgesia are scant and have shown conflicting results, the present study was conducted. **METHODS:** A total of 90 children aged between 3-6yrs belonging to ASA class I and II undergoing surgical procedures below the umbilicus were randomly allocated to one of two groups: Group R received ropivacaine 0.2%, 1 ml/kg with saline 0.02ml/kg and Group RF received ropivacaine 0.2%, 1 ml/kg with fentanyl 1 µg/kg (0.02ml/kg) and Group RC (clonidine) received 1ml/kg of 0.2% Ropivacaine plus clonidine 2µg / kg caudally after induction of general endotracheal anaesthesia. The pain score was evaluated using Hannallah pain scale, motor blockade using modified bromage scale and sedation assessed using 4 point sedation score at 30 minutes after extubation and at 1, 2, 4, 6, 12 and 24 h. The time to awakening, first analgesic requirement time, number of doses of rescue analgesic and side-effects in a 24 hours period were also recorded. The results were evaluated using SPSS 17 statistical method. **RESULTS:** There were no differences in demographic characteristics between the groups. However, mean duration of caudal analgesia was 659.5 minutes in group R, 784.5 minutes in group RF and 960.5 minutes in group RC which was statistically highly significant (P<0.01). The total dose of rescue analgesic in 24 hours was lower in groups RF and RC. Also the number of children receiving rescue analgesia at 12 hours was higher in placebo group than fentanyl group and clonidine group which was statistically highly significant (P<0.01). Increased incidence of urinary retention and pruritis was noted in group RF which was statistically not significant (P=0.366). **CONCLUSION:** Addition of inj. Fentanyl 1µg/kg or clonidine 2µg/kg to Ropivacaine 0.2% 1ml/kg prolongs the duration and improves the quality of analgesia post operatively when compared with Ropivacaine alone. However, clonidine is a better adjuvant to Ropivacaine 0.2% 1ml/kg for single shot caudal block in children undergoing infraumbilical surgeries due to more prolonged analgesia and lesser side effects.

**KEYWORDS:** Caudal analgesia. Adjuvant to local anesthetics. Ropivacaine. Clonidine, Fentanyl.

**INTRODUCTION:** Caudal block is the most popular, reliable, safe method of perioperative analgesia in pediatric patients. This technically simple block provides intra operative and post-operative analgesia, reduces the general anesthetic requirement, attenuates stress response to surgery, affords earlier recovery of airway reflexes, and contributes to a comfortable awakening in a cost effective manner.<sup>1,2,3</sup>

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Ropivacaine, an amino amide local anaesthetic (LA) is one of the recent additions to family of long acting local anesthetics in India with a better safety profile and less motor blockade than bupivacaine. Various studies have confirmed efficacy of caudal Ropivacaine 0.2% 1ml/kg in providing effective analgesia.<sup>2-6</sup> The duration of analgesia provided by single shot caudal block is limited even with the use of long acting local anesthetics. Use of opioids, Alpha- 2 agonists like clonidine and dexmedetomidine, ketamine, neostigmine, along with LAs has been well documented to prolong the duration of single shot caudal block.<sup>7-11</sup>

Fentanyl, a potent synthetic opioid is being widely used in practice of central neuraxial blockade with bupivacaine in past decade or two in adults. A fewer studies have been done on effect of fentanyl as an adjuvant to Ropivacaine for prolongation of caudal analgesia in children.<sup>4,5,9</sup> Clonidine, an alpha-2 agonist is a known antihypertensive agent. Because of its sedative and analgesic effects, it is now widely used as an adjuvant in central neuraxial blocks and also peripheral nerve blocks.<sup>11-15</sup> Also, few studies done on its efficacy as caudal adjuvant have shown prolongation in pediatric patients.<sup>7,16-18</sup>

However, studies comparing these two well-known adjuvants added to ropivacaine for caudal analgesia are sparse.<sup>4</sup> Hence we conducted the present study to compare the adjuvant effect of fentanyl 1 µg/ kg or clonidine 2 µg/ kg to 0.2% Ropivacaine 1ml/kg on the duration of analgesia after a single shot caudal block in children undergoing infraumbilical surgeries.

**METHODOLOGY:** We conducted the present prospective, randomized, double blind, controlled clinical study in Cheluvamba and Krishna Rajendra Hospital, attached to Mysore Medical College and Research Institute, Mysore from November 2011 to July 2013 after ethical committee clearance. 90 children in the age group of 3 years to 6 years belonging to ASA class I, posted for routine paediatric infraumbilical short surgical procedures were selected for the study. The study population was randomly divided into three groups of 30 each by an opaque sealed envelope technique.

The exclusion Criteria included age less than 3 years of age and more than 6 years, children with co-existing medical illness, coagulation disorders, anatomical abnormalities of the spine, obese (Body weight >30 kg), local infection in the caudal area. The data was collected in the pre tested proforma consisting of age, sex, etc., meeting the objectives of the study. Pre-operative assessment was done for each patient and written informed consent was taken from parents. These children were pre medicated with syrup midazolam 0.02 mg/kg 30 minutes before surgery. Pre oxygenation was done for 3 min. Arterial pressure (non-invasive), peripheral oxygen saturation (SpO<sub>2</sub>) and electrocardiography was monitored (using L & T: STAR PLUS turbo) in all children intra operatively.

Anaesthesia was induced by facemask with sevoflurane, nitrous oxide 50% and 50% oxygen. (Glycopyrrolate or Atropine were given or not, if not why) Indication for use of anticholinergics like airway surgeries, awake intubation, infants < 6 months, use of repeat dose of succinylcholine or use of potent inhalational agents like halothane were not there in our study population (Miller anaesthesia 7<sup>th</sup> edition, chapter 82 page 2575). Hence inj atropine/inj glycopyrrolate were not given.

After placement of an intravenous cannula, the trachea was intubated using inj. succinyl choline 1.5mg/kg. Anaesthesia was maintained with sevoflurane 1%, oxygen and nitrous oxide and inj. atracurium 0.5mg/kg and manually ventilated. Caudal block was performed in the lateral position with 22 gauge blunt tipped, short bevel, hypodermic needle by an experienced anesthesiologist who had given at least 50 caudal blocks.

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- Group R (normal saline) received Ropivacaine 0.2%, 1 ml/kg with saline 0.02ml/kg and
- Group RF (Fentanyl) received Ropivacaine 0.2%, 1 ml/kg with Fentanyl 1 µg/kg (0.02ml/kg).
- Group RC (clonidine) received 1ml/kg of 0.2% Ropivacaine plus clonidine 2µg / kg (diluted one in three times to make dose as 0.02ml/kg).

Anaesthesiologist who administered the drug and the observer were blinded to the drug. Sterile syringes containing equal volumes of the drug or placebo were loaded by another anaesthesiologist not concerned or participating in the study. The intra operative monitoring and post-operative observation was done by the same anaesthesiologist who administered the drug or placebo but was unaware of the content of the syringes. Heart rate (HR), mean arterial pressure (MAP) and SpO<sub>2</sub> were recorded before induction, after intubation, 10 minutes after caudal block i.e., at the time of surgical incision and at extubation.

During surgery, adequate analgesia was defined by hemodynamic stability, as indicated by the absence of an increase in MAP or HR of more than 15% to skin incision compared with baseline values obtained just before the surgical incision. If HR or MAP increased by more than 15%, analgesia was considered inadequate (failed caudal) and subsequent data obtained from those children were no longer considered and excluded from the study.

During surgery, children received ringer lactate solution 5 ml/ kg/ hr. Inj ondansetron 0.1mg/kg and inj. dexamethasone 0.15mg/kg were given i.v, to prevent post-operative nausea and vomiting. (antiemetics may not be required in all the cases) The study drugs include an opioid which is known to cause nausea and vomiting. Also, nausea and vomiting is one of the side effects of ropivacaine. Hence, the above drugs were given.

At the completion of the surgery, the children were reversed with inj. neostigmine 0.05 mg/kg and inj. atropine 0.02mg/kg and extubated. The analgesic effect of caudal block was evaluated using the Hannallah Pain Scale (HPS) [table-1] at 30 min after extubation and at 1, 2, 4, 6, 12 and 24 hours. When the HPS score was greater than 4, syrup paracetamol 10mg/kg orally was given as rescue analgesic and time was noted. Assessment of the duration of analgesia was performed by comparing the time from caudal block to administration of the first dose of rescue analgesic. Total number of doses of rescue analgesic within the first 24 hours was also recorded.

Sedation was assessed using 4 point sedation score [Table-2] and motor blockade using modified bromage scale [table-3] soon after extubation and at 30 min, 1, 2, 4, 6, 12 and 24 hours. Respiratory rate and SPO<sub>2</sub> were also noted at similar intervals of time. The durations of surgery and anaesthesia, incidence of side-effects (vomiting, urinary retention, respiratory depression and pruritus), were also recorded.

OBSERVATION	CRITERIA	POINTS
Arterial pressure	+ 10% pre-operative	
	>20% pre-operative	
	> 30% pre-operative	
Crying	No crying	
	Crying responded to tender loving care(TLC)	
	Crying not responding to TLC	

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Movement	None	
	Restless	
	Thrusting	
Agitation	Asleep/ calm	
	Mild	
	Hysterical	
Posture	No special posture	
	Flexing legs and thighs	
	Holding groin	
Complains of pain	Asleep/ states no pain	
	Cannot localize pain	
	Can localize pain	

**Table 1: Hannallah pain scale**

Table 2: Four point sedation score:

1. Asleep, not arousable by verbal contact.
2. Sleep, arousable by verbal contact.
3. Drowsy not sleeping.
4. Alert/ awake.

Table 3: Modified Bromage scale:

- Bromage 0- Patient is able to move the hip, knee and ankle.  
 Bromage 1- Patient is unable to move the hip but able to move the knee and ankle.  
 Bromage 2 - Patient is unable to move the hip and knee but able to move the ankle.  
 Bromage 3 - Patient is unable to move the hip, knee and ankle.

### DEFINITIONS:

**DURATION OF SURGERY:** Time from skin incision till the placement of last suture

**DURATION OF ANAESTHESIA:** Time from induction of anaesthesia till extubation.

**DURATION OF CAUDAL ANALGESIA:** Time from caudal analgesia to administration of first dose of rescue analgesic.

**RESPIRATORY DEPRESSION:** Respiratory rate less than 14 anytime during first 24 hours.

**URINARY RETENTION:** inability to void urine at least 6 hours after surgery in spite of a full bladder.

**STATISTICAL ANALYSIS:** The pilot study done revealed the required sample to be 30 in each group for avoiding skewness in time to first rescue analgesic, and the level of significance and the power of the study were fixed as 0.05 ( $\alpha$ ) and 0.9 ( $1 - \beta$ ). Analysis was done by SPSS17 statistical method. Descriptive statistics, mean and standard deviation, were calculated for continuous variables, and frequency and percentage were calculated for qualitative measurements.

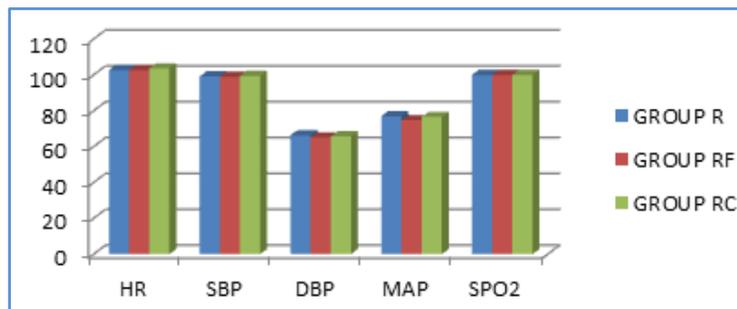
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Independent t- test was used for between- group comparisons among categorical variables. A one-way analysis of variance (ANOVA) was used to test whether the means of continuous variables were different among the groups.

The results were compared at 0.05 and 0.01 levels of significance for the corresponding degrees of freedom,  $p < 0.05$  (Significant),  $p > 0.05$  (not Significant) and  $p < 0.01$  was considered highly significant.

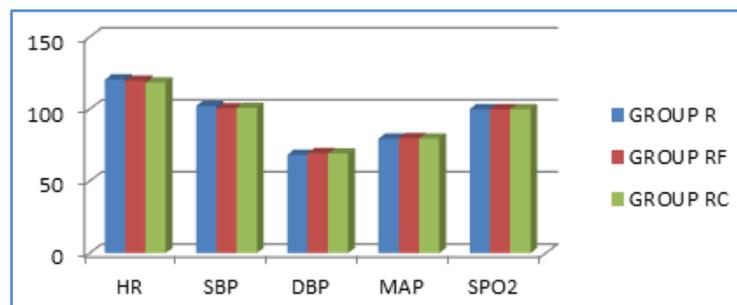
**RESULTS:** There were no statistically significant differences among the three groups in demographic data like age, sex, weight and height and also the types of surgical procedures. The standard mean durations of surgery were 24.5 minutes, 23.8 minutes and 20.8 minutes in groups R, RF and RC respectively. The standard mean durations of anaesthesia were 39.5 minutes, 39 minutes and 35.8 minutes in groups R, RF and RC respectively. The pre-op, intra-op and post-op haemo dynamic changes between the groups were comparable and therapeutic interventions were not required

**Figure 1:** Comparison of haemodynamic variables soon after skin incision.



**Figure 1**

**Figure 2:** Comparison of haemodynamic variables soon after extubation.

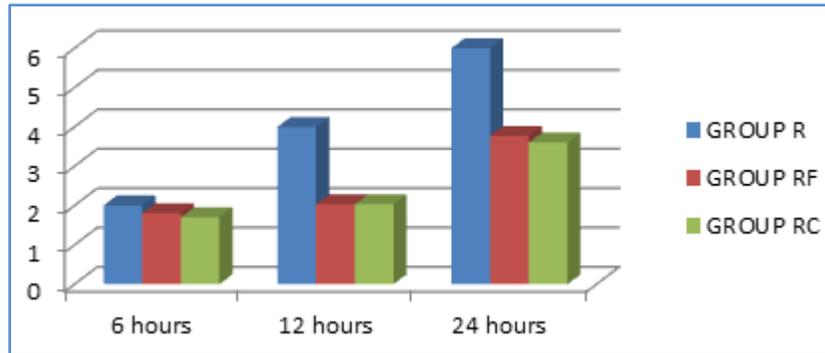


**Figure 2**

The standard mean durations of caudal analgesia in R, RF, and RC groups were  $659.5 \pm 18$  minutes,  $784.5 \pm 25$  minutes and  $960.5 \pm 66$  minutes respectively which was statistically highly significant ( $p < 0.01$ ).

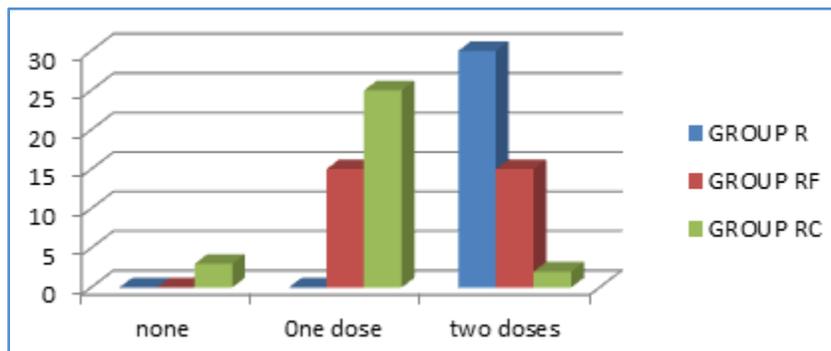
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**Figure 3:** Comparison of mean Hanallah Pain Scale (HPS) scores at 6, 12 and 24 hours. HPS scores were significantly higher in group R compared to group RF and RC at 12 and 24 hours ( $p < 0.01$ ). The lower mean HPS scores at 12 hours in RF and RC groups compared to group R (inspite of all children receiving rescue analgesia) means that the quality of postoperative analgesia was better in RF and RC groups compared to group R. Thus, children in RC group had better quality and prolonged analgesia compared to other groups.



**Figure 3**

**Figure 4:** Comparison of number of doses of rescue analgesia between the groups



**Figure 4**

25 out of 30 children (83%) in RC group required a single dose of rescue analgesia compared to 15 children out of 30 (50%) of RF group and none (0%) in group R. Higher incidence of pruritus and urinary retention was noted in RF group (6.7% and 3.3% respectively) compared to none in R and RC groups. However, it was statistically not significant ( $p = 0.399$ ).

The mean sedation scores were comparable in all groups at all times except at extubation and 30 minutes post extubation. It was higher in RC group compared to R and RF groups at 30 minutes. However, such children in RC group were arousable by verbal contact (mean sedation score = 2). The post-operative oxygen saturation and respiratory rate were comparable in all three groups. Motor blockade was not reported in any groups.

**DISCUSSION:** Ropivacaine has comparable properties to bupivacaine but with a better safety profile and less motor blockade.<sup>1-3,19-22</sup> Studies have demonstrated that Ropivacaine 0.2% provided satisfactory postoperative pain relief and minimal incidence of motor block.<sup>23,24</sup>

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The surgical procedures undertaken in our study population required blockade of lumbar and sacral fibers. Various studies have confirmed efficacy of Caudal Ropivacaine 0.2% 1ml/kg in providing effective analgesia for infra umbilical surgeries.<sup>2,3,4,5,6</sup> Also, the dose of 1ml/kg of 0.2% Ropivacaine is known to be well below the toxic threshold,<sup>25-27</sup> the toxic threshold being 4µg/ml. Hence, we selected 1ml/kg as the volume of 0.2% Ropivacaine.

Opioids are the most commonly used adjuvants. Morphine, among the opioids is the gold standard for analgesia. Since morphine is known to produce delayed and prolonged respiratory depression, fentanyl is more commonly used in children for caudal analgesia as its safety has been confirmed in pediatric population.<sup>28,29</sup> The dosage of fentanyl as additive to caudal Ropivacaine was based on the study conducted by Yaddanapudi et al.<sup>30</sup> They found that 0.5µg/ml of fentanyl was ineffective as adjuvant to caudal block and suggested a dose of 1µg/kg as adjuvant to local anaesthetics. Higher doses cause increased incidence of side effects like bradycardia, pruritus and urinary retention.

Clonidine, an  $\alpha_2$  adrenergic agonist has been used widely as an adjuvant to local anesthetics to enhance the quality of analgesia in the postoperative period. The analgesic action of epidurally administered clonidine is due to alteration of nociceptive neurotransmitters in the dorsal horn of spinal cord.<sup>11,18</sup> The analgesic effect of clonidine is more pronounced after neuraxial injection, which suggests a spinal site of action.<sup>11,18</sup> The dose of clonidine was based on the studies in the pediatric population.<sup>18,31</sup>

In our study, the mean time to rescue analgesia (TTRA) was 659.5 minutes in placebo group, 784.5 minutes in fentanyl group whereas 960.5 minutes in clonidine group which was statistically highly significant ( $P < 0.01$ ). Shukla U et al.<sup>4</sup> concluded that both fentanyl and clonidine have comparable properties as adjuvant to ropivacaine but clonidine offers a better side effect profile. However, in our study although the quality of postoperative analgesia by fentanyl and clonidine were similar, the duration of analgesia was significantly prolonged in clonidine group compared to fentanyl group ( $p < 0.01$ ).

Manickam A et al.,<sup>16</sup> Laha A et al.<sup>18</sup> and Bajwa SJS et al.<sup>19</sup> reported improved quality of analgesia with the addition of clonidine (2 mcg/kg) to ropivacaine. However, the different pain scale used may have caused the difference in duration of analgesia compared to our study. Singh J et al.<sup>9</sup> and Shukla U et al.<sup>4</sup> also found that addition of fentanyl prolongs the duration of analgesia provided by Ropivacaine. However, Kawaraguchi et al.,<sup>5</sup> who found that there was no statistically significant prolongation of TTRA in Fentanyl group. This difference may be because of the sample size of their study which included only 36 children with 18 children in Fentanyl group.

Increased incidence of side effects like pruritus, urinary retention was noted only in Fentanyl group in our study. However it was statistically not significant. Singh J et al.<sup>9</sup> also noted a similar incidence of urinary retention in their study which was also statistically not significant. However, Shukla U et al.<sup>4</sup> did not report any incidence of urinary retention in their study. Epidural administration of clonidine can cause bradycardia due to parasympathetic predominance and hypotension as a result of inhibition of preganglionic sympathetic fibres. However, none of the children required intervention as the hemodynamic parameters were not below the defined criteria.

This finding is similar to studies conducted by Manickam A et al.<sup>16</sup> and Shukla U et al.<sup>4</sup> The absence of motor blockage in all three groups confirms the safety of ropivacaine 0.2% 1ml/kg for caudal analgesia in pediatric patients.

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**CONCLUSION:** We conclude that addition of inj. Fentanyl 1µg/kg or clonidine 2µg/kg to Ropivacaine 0.2% 1ml/kg prolongs the duration and improves the quality of analgesia post operatively when compared with Ropivacaine alone. However, clonidine is a better adjuvant to Ropivacaine 0.2% 1ml/kg for single shot caudal block in children undergoing infraumbilical surgeries due to more prolonged analgesia and lesser side effects. (Citing of references should be in VANCOVER style)

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