

Original Research Article

Comparative evaluation of caudal tramadol and fentanyl when mixed with bupivacaine in paediatric age group

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ABSTRACT

Background: A caudal block is commonly performed block for postoperative analgesia pediatric surgeries. Duration can be enhanced by addition drugs like fentanyl, tramadol, clonidine midazolam etc to local anesthetics helps in decreasing the requirement of postoperative analgesics. This study was conducted to assess the analgesic efficacy of tramadol or fentanyl when mixed with bupivacaine in pediatric patients for surgeries below the umbilicus.

Methods: Fifty children of ASA I and ASA status, between 2 to 12 years of age, of both sexes underwent elective surgeries below umbilicus were selected and randomly divided into groups of 25 each. One Group, T (n = 25) received 0.75 ml/kg of 0.25% bupivacaine with tramadol 1mg/kg and other Group F (n = 25) received 0.75 ml/kg of 0.25% bupivacaine with Inj fentanyl 1µg/kg. Assessment of analgesia and any side effects after caudal injection to the first administration of analgesia were recorded for both the groups in next 24 hours following objective pain scores. Duration of analgesia and requirement of additional rescue analgesics was noted.

Results: The Mean duration of analgesia recorded longer in Group T (18.26±6.1 hours) as compared to Group F (10.0±2.68 hrs.) and no significant haemodynamic changes or adverse effect noted between 2 groups.

Conclusions: Addition of tramadol, 1mg/kg to bupivacaine 0.25% for caudal anesthesia in children undergoing surgeries below umbilicus, enhances and prolongs postoperative analgesia compared to caudal fentanyl 1µg/kg and bupivacaine 0.25% alone.

Keywords: Analgesia, Caudal epidural, Fentanyl, Postoperative, Tramadol

INTRODUCTION

The International Association for the study of pain has defined pain as “an unpleasant sensory and emotional experience, associated with actual or potential tissue damage.”¹

As per International association of study of pain, the importance of treatment of pain in infants and neonates was considered as an important responsibility and to be treated as effectively as was done in other group of patients.² The alleviation of pain has been the focus of

continuing human effort. However, it has been recognized for some time that the management of acute pain, specially, in the post-operative period has been consistently not given adequate attention. The situation especially being worse in children who have not been given adequate attention and have been frequently been under treated for acute post-operative pain in form of under dosing.³ This has happened for the fear of over dosage and also lack of knowledge of the side effects of the drugs. Fortunately, attitudes to treating pain in infants have changed dramatically during the past 15 years. Nevertheless as recently as 1987, Yaster was prompted to

write in his editorial that it is not justified to continue to neglect the safe application of analgesics in our youngest population of patients.⁴

Reasons for withholding analgesia are many and diverse, most important were a general notion that the degree of response of children to pain is not the same as that of adults. There was ignorance about how safe and efficacious analgesics in infants and neonates are.^{5,6}

The last few years has shown an increase in the understanding of pharmacokinetics and pharmacodynamics of analgesics and diversity in available modes of treatment of pain in children. Various aspects pain relief like of oral and parenteral administration of analgesic drugs. Surgical procedures under spinal, epidural anesthesia, caudal anesthesia, Nerve blocks like intercostal block, penile block and wound infiltration by local anesthetic drugs.

Caudal block is one of the most commonly used regional anesthetic technique as an adjunct to GA for lower abdominal surgeries due to the availability of safe local anesthetics. It prevents the establishment of winding up by blocking sensory input which induces central sensitization.

The surgical model of pre-emptive analgesia acknowledges that, the initial tissue injury of surgery is followed, in hours to days, with an inflammatory reaction to the damaged tissues. This secondary response of inflammation continues during wound-healing process. This model indicates that a single mode of pre-emptive treatment may be insufficient to relieve postoperative pain because it would not be able to control the pain of inflammation in the post-operative period. Thus, what is needed is pre-emptive analgesia in an uninterrupted way. These could encompass a variety of modalities such as NSAIDs to reduce the peripheral activation/ sensitization of nociceptors, local anesthetics that prevent the sensory inflow, and opiates acting on the central receptors in the spinal cord to prevent central sensitization during the postoperative period.⁷

In various studies it was observed that pre-emptive caudal analgesia not only leads to decreased pain scores and also longer time to first dose of rescue analgesic. They also decreased consumption of morphine and other adjuvant drugs in the post- op period.⁸

Local anesthetics have a short duration of action so do not provide sufficient duration of analgesia in post-op period. The use of adjuvants in caudal block has several advantages. Morphine was used very commonly in 1970's but associated with numerous side effects.⁹ Availability of newer opioids like tramadol and fentanyl when added to the local anesthetics in caudal block enhance and prolongs the pain relief in compare to the local anesthetics alone. They also decrease the dose of

both with lesser side effects as associated drugs like morphine /epinephrine etc.

In view of the above, this study was undertaken to evaluate the efficacy and safety of tramadol and fentanyl as an adjuvant to local anesthetics, when given in caudal epidural in children undergoing lower abdominal surgeries under GA.

METHODS

After approval by the hospital ethics committee and written informed parental consent, we enrolled 50 fifty children with inclusion criteria were having ASA I and ASA II physical status, age group between 2 to 12 years of age, of both sexes, who underwent elective surgeries below umbilicus.

Children excluded from the study were the one with known allergy to local anesthetics, bleeding diathesis, presence of septic focus on the skin over the caudal region, any bony abnormality of the sacrum, pre-existing neurological disease or ASA III and below were excluded from the study.

This study was conducted in operation theatre of zonal hospital of armed forces hospital for one year duration, starting from Apr 2017 to Mar 2019. Patients enrolled for the study were randomly divided into two equal groups of 25 each and studied for the effects of bupivacaine with tramadol and bupivacaine with fentanyl after giving single shot caudal epidural block.

Patients were fasted for 6 hours before the procedure. Clear fluids were allowed up to 2 hours before the procedure. Premedication with syrup midazolam 50 µgm/kg along with syrup paracetamol 20 mg/kg was administered 45 min before surgery in the pre-operative room. An intravenous line was started inside the operating room after placement of a prilocaine patch at the site of IV cannulation for 20-25 minutes. Premedication was given with inj glycopyrrolate 5-10 µg/kg and inj fentanyl 1-2 µg/kg. Patients were induced with inj thiopentone 5-6 mg/kg IV, dose titrated to effect. Inj vecuronium was used to facilitate intubation. Endotracheal tube was used to maintain the airway. Maintenance of anesthesia was done with oxygen + nitrous oxide + sevo / isoflurane. Inj vecuronium was used for muscle relaxation.

Caudal block was performed after induction and before the start of surgery, using standard aseptic precautions in the left lateral position with the legs flexed. The landmarks of posterior superior iliac spines and sacral cornua were identified by palpation and further confirmed by the formation of an equilateral triangle by the posterior superior iliac spine and sacral hiatus. The resilient feel of the sacro-coccygeal membrane was felt with the thumb and over this the skin was pierced at an angle of 60 degrees. The needle was then redirected at an

angle of 45 degrees and the sacro-coccygeal membrane was pierced. Now the needle was made parallel to the skin and advanced by 2-3 mm. The correct placement of needle in the epidural space was confirmed by aspiration of air bubbles in the syringe full of the drug solution to be administered.

Before giving the drug it was ensured that the needle tip was not in a blood vessel and that the dura has not been punctured. In case CSF is aspirated the procedure is abandoned. In case of aspiration of blood, needle is removed and reinserted with a slight change of direction and if there is no blood on aspiration, the drug is injected. The needle is pulled out in one go and the site of puncture sealed with povidone iodine dressing to avoid infection. In case of 2-3 failed attempts in locating the caudal epidural space, the procedure was abandoned.

The patient was monitored using standard monitoring i.e. systolic blood pressure (noninvasive), pulse-oximetry, heart rate, capnography and ECG during the course of surgery. Intravenous fluids were given as per requirement. The neuromuscular blockade was reversed with inj neostigmine and inj atropine/inj glycopyrrolate at the end of surgery. Post-operative monitoring was done in the post-anesthesia care unit (PACU) for 2-3 hours and in the ward using a standard proforma for next 24 hours.

The assessment of pain relief was done by using an objective pain score (Hannallah-Broadman). In addition the following parameters were noted, duration of surgery, duration of pain free period and time to void. Monitoring of complications namely - nausea, vomiting, motor weakness, respiratory depression, sedation, hypotension and bradycardia. At the onset of pain, rescue analgesia was given as appropriate and the total duration of analgesia was noted.

Statistical analysis included profiling of patients on different demographic and clinical parameters etc. Quantitative data will be presented in terms of means and standard deviation. Qualitative/categorical data were presented as absolute numbers and proportions. Student t test was used for comparison of individual quantitative parameters. Cross tables were generated and chi square test was used for testing of associations. P-value < 0.05 is considered statistically significant. SPSS software was used for analysis.

RESULTS

In this study 50 children registered after applying exclusion and inclusion criteria and were divided into two equal groups of 25 each. The data collected was analyzed using unpaired 't' test. In this study both groups were analyzed and compared.

On observing demographic profile, time from caudal block to surgical incision, duration of surgery, duration of

general anesthesia and time to extubation, it was similar in both groups (Table 1).

Table 1: Demographic data.

Mean	Group F	Group T
Age (years)	5.4±2.9	4.5±2.3
Weight (kgs.)	14.9±6.5	14.3±4.6
Duration of surgery (min)	90 (85-105)	100 (80- 110)
Duration of GA (min)	100	108

On comparing the type of surgical procedures below umbilicus like herniotomy, hypospadias, orchidopexy, circumcision and other below umbilical surgeries, it was observed that both groups were similar with non-significant difference as shown in Table 2.

Regarding duration of analgesia on comparison of both groups, the Group T (tramadol 1 mg/kg and bupivacaine 0.25% resulted in significantly longer post-operative analgesia (18.26 hours + 6.1 hours.) compared with Group F (Fentanyl 1µg/kg and Bupivacaine 0.25%) (10.0 hours + 2.68 hours.). This was confirmed by a significantly longer time interval to the first request for rescue analgesia (paracetamol/pethidine) in group T. (t=6.2, p<0.001, significant) (Table 3).

Table 2: Type of surgical procedures.

Procedure	Group F	Group T	Total
Herniotomies	14	11	25
Hypospadias repair	3	7	10
Orchidopexy	2	1	3
Circumcision	6	6	12
Total	25	25	50

Table 3: Post-operative analgesia-time to first administration of oral paracetamol/brufen.

Group F	Group T
10.0 hrs+2.68 hrs.	18.26 hrs+6.1 hrs.

Duration of post op analgesia was assessed by the interval at which rescue analgesia was administered to the children as assessed by the pain assessment score , the children were given rescue analgesia in the form of oral paracetamol / brufen (dose as per weight) whenever the pain score was 4 out of 12 or more (Table 4).

Quality of analgesia in the first 4 hours postoperatively, no child in the T group required compared to four children in the F group, who required paracetamol whereas after 6 hours two children in the T group and eight children in the F group required supplemental analgesia. At the end of 12 hours, eleven children received rescue analgesia in F group as compared to only four children in the T group. After caudal block in T

Group no rescue analgesia required in the first 24 hours postoperatively, compared to none in group F (Table 4).

Table 4: Duration of post-operative analgesia.

Description	Group F	Group T
Time interval to first request for rescue analgesia	10.00 hrs.	18.26hrs
Total number of analgesic requests up to 24 hrs.	22	12
Average pain score group F (n = 25) group T (n = 25)		
2 hours	0.08	0
4 hours	0.4	0.08
6 hours	1.2	0.4
8 hours	1.4	0.8
12 hours	1.8	1.2
18 hours	3.0	1.8
24 hours	4.4	2.4

Table 5: Postoperative side-effects after combined caudal and general anesthesia with fentanyl/tramadol.

Side effect	Fentanyl N = 25	Tramadol N = 25
Vomiting	2	8
Paraesthesia	0	0
Postoperative leg weakness (4 hours.)	0	0
Postoperative urinary retention	6.41 hours	8.25 hours
Excessive sedation	0	0
Bradycardia	0	0
Hypotension	0	0

Regarding adverse reactions like vomiting, paraesthesia, post-operative leg weakness, post-operative urinary retention and excessive sedation. There was significant difference in the incidence of vomiting and urinary retention. In T group incidence of vomiting and post-operative urinary retention was more than F Group. (Table 5).

DISCUSSION

The most important symptom which brings a patient to a doctor is pain, so effective management of pain is most important and justifies the existence of all anesthesiologists as analgesia is important component of anaesthesia. Adequate pain control is an extremely important aspect of postoperative care. This helps in the psychological wellbeing of the patient, decreases the stress response to surgery resulting in a favourable outcome.¹⁰ It is important to treat pain in children as the child may not possess enough vocabulary to express the severity of pain and also our lack of communication skills hamper our ability to effectively communicate with the child and thus history may not be complete. In addition our tendency to under treat pain, because of our

prejudices and the perception that we have limited modalities and lastly the misconception that children do not feel pain though pain being an unpleasant sensory stimulus is totally subjective though children experience it they fail to express it and they also that their wellbeing is looked after by their care givers .however it has now been proven that children do feel pain in the same degree as adults which results in adverse physiological and psychological effects similar to those in adults.¹¹

In the last few years concept of providing adequate postoperative analgesia is well established but use of IV opioids was associated with side effects such as respiratory depression. Caudal anesthesia has established benefits in the management of postoperative pain for surgeries in the ano-perineal region and lower abdomen in pediatric age group as:

- Safe and easy to perform.
- Reliable results
- Requires no special equipment
- Minimal hemodynamic changes.
- Applicable to children of all ages including neonates
- Useful for day care surgery and anesthesia

Caudal is usually given after induction of general anesthesia as it helps both in intra-operative and postoperative period and reduces the requirement of inhalational agents during the intraoperative period.^{12,13}

Bupivacaine is the most commonly used long acting local anesthetic for caudal epidural block in children but has been found to have its own side effects which includes motor weakness, urinary retention, and CVS and CNS toxicity which we observed in our study also. Adjuvants were added to local anesthetics to prolong the duration of analgesia and also decrease the toxicity of local anaesthetics.^{10,14}

Opioids, especially morphine or hydromorphone, substantially prolong analgesia from caudal blocks. Krane et al compared three doses of caudal epidural morphine in children aged 1.2 -7.9 years doses of 0.033 mg/kg, 0.067 mg/kg and 1.10 mg/kg of preservative free morphine were used, they found prolongation of duration of analgesia in the last group. The incidence of side effects like vomiting, pruritus and urinary retention are same. In further studies the addition of tramadol or midazolam to caudal epidural ropivacaine prolongs the duration of analgesia without causing significant side effects.^{9,15} Batra et al, found that tramadol has been found to decrease the MAC values of the volatile anesthetic requirements in the intraop-period. Tramadol has a low lipid solubility so there is slow resorption from the extradural space into the spinal site of action which may be responsible for slow onset of action.^{16,17}

In one study using fentanyl and bupivacaine, at the end of anesthesia, there was no difference in the plasma level of E and NE as compared with bupivacaine alone.¹⁸

Prakash et al compared three doses of tramadol 1 mg/kg, 1.5 mg/kg and 2 mg/kg of tramadol mixed bupivacaine 0.25% 0.75 ml/kg. They found that dose of 2mg/kg provided longer duration of postoperative analgesia and reduction in requirement of rescue analgesic.¹⁹

The study also demonstrates a marked synergistic effect of the combined caudal injection of tramadol and bupivacaine over fentanyl in prolonging postoperative analgesia in children. Caudal bupivacaine 0.25% with addition of tramadol 1.0 mg/kg provided postoperative analgesia for 18.26±6.1 hours (mean±SD) compared to 10.0±2.68 hours when fentanyl was added to bupivacaine 0.25%.

An even more pronounced prolongation of caudal analgesia was achieved in our study (18.26±6.1 hours in group T vs 10.0±2.68 hours in group F), which might be explained by the type of surgery, the resulting intensity of postoperative pain and the combination of analgesic drugs that were used. Any significant motor or sensory blockade did not found 4 hours postoperatively. The number of children in group T requiring rescue analgesia in the first 24 hours was only 12 which is significantly less, when compared to group F in which as many as 22 children needed rescue analgesia within the first 24 hours.

Higher incidence of vomiting was observed in the tramadol group, the same observations were made by Gunduz et al when he compared two groups one with plain bupivacaine and other with bupivacaine with tramadol. There was no incidence of excessive sedation or hypotension, as seen with higher doses of caudally administered tramadol.²⁰

Solanki et al observed duration of with caudal anesthesia was significantly prolonged with tramadol as compared to fentanyl without any side effects. A time-dependent sedative effect of epidural tramadol and fentanyl are well known but there was no significant difference in sedation scores of both drugs 2 hours and 6 hours. Post-operatively though both drugs produce a profound sedative effect. This is desirable as the child is more calm and comfortable in the immediate postoperative period.²¹

The duration of urinary retention in case of group-T was found to be 8.25±1.41 hours and in group-F was found to be 6.41±1.48 hours which was significantly longer in group T. In present study two identical twins who underwent urethroplasty for hypospadias both had a slightly longer sacral hiatus as compared to other children. Similar duration of analgesia in both the children (12 and 12.2 hours) was observed. This can be explained on the basis of similar genetic constitution.

CONCLUSION

Adding tramadol 1mg/kg to bupivacaine 0.25% for caudal anesthesia in children undergoing inguinal

surgeries, enhances and prolongs postoperative analgesia compared to caudal fentanyl 1µg/kg and bupivacaine 0.25% alone. This could be a safe and cost-effective alternative to extradural catheter placement for surgical procedures of intermediate duration. Tramadol may be considered as the drug of choice in spite of its increased incidence of vomiting and longer duration of analgesia as compared to fentanyl.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. International association for the study of pain. Pain terms: a list with definitions and notes on usage. *Pain* 1979;6:249-51.
2. Rogers M. Do the right thing-pain relief in infants and children. *NEJM*. 1992;326:55-6.
3. Cohen M, Quintner J, Rysewyk S. Reconsidering the IASP definition of pain. *Pain Reports*. 2018;3:634.
4. Ivani G, Negri P, Lonnqvist PA, Erario M, Mossetti V, Difilippo A, et al. Caudal anesthesia for minor pediatric surgery: a prospective randomized comparison of ropivacaine 0.2% vs levobupivacaine 0.2%. *Paediatr Anaesth*. 2005;15:491-4.
5. Yaster M. Analgesia and anesthesia in neonates. *J Pediatric*. 1987;111:394-6.
6. Murdoch LJ, Cashman JN. Pediatric pain relief. Recent advances in anesthesia and analgesia. Churchill Livingstone. 1995;19:127-44.
7. Kumar A. Pediatric pain: perception, assessment and management. *J Anesth Clin Pharmacol*. 1997;13:99-111.
8. Batra MS. Regional anesthesia in ambulatory surgery: contemporary issues. *Regional anesthesia and Pain management*. Churchill Livingstone; :304-309.
9. Krishnadas A, Suvarna K, Hema VR. A comparison of ropivacaine, ropivacaine with tramadol and ropivacaine with midazolam for post-operative caudal epidural analgesia. *Indian J Anaesth*. 2016;60:827-32.
10. Nishiyama T, Hirasaki A, Odaka Y. Saline optimal dose for postoperative pain. *Japanese J Anesthesiol*. 1992;41(1):49-54.
11. Schechter NL. Status of pediatric pain control. A comparison of hospital analgesic usage in children and adults. *Paediatrics*. 1986;69:1441-4.
12. Raffa RB. Complimentary and synergistic anti-nociceptive interaction between enantiomers of tramadol. *J Pharma Experiment Therap*. 1993;267:331-40.
13. McGown RG. Caudal analgesia in children. *Anaesthesia*. 1982;37:806.
14. Kundra P, Deepalakshmi K, Shankar RM. Pre-emptive caudal bupivacaine and morphine for

- postoperative analgesia in children. *Anesth Analg.* 1998;87:52-60.
15. Krane EJ. Caudal morphine for postoperative analgesia in children a comparison with caudal bupivacaine and i.v. morphine. *Anaesth Analg.* 1987;66(7):647-52.
 16. Batra YK. Comparison of caudal tramadol vs. Bupivacaine for postoperative analgesia in children undergoing hypospadiasis surgery. *Int J Clin Pharmacol Therap.* 1999;37(5):238-42.
 17. Fu YP. Epidural tramadol for postoperative pain relief. *Acta Anaesthesiologica Scand.* 1991;29(3):648-52.
 18. Bum AGL. Clinical pharmacokinetics of epidural and spinal anesthesia. *Clin Pharmacokin.* 1989;16:283-311.
 19. Prakash S. Efficacy of three doses of bupivacaine for caudal analgesia in pediatric inguinal herniotomy. *Br J Anaesth.* 2006;97:385-8.
 20. Gunduz M, Ozcengiz D , H Ozbek. A comparison of single dose caudal tramadol, tramadol plus bupivacaine and bupivacaine administration for postoperative analgesia in children. *Pediatric Anesthesia.* 2001;11(3):323-6.
 21. Solanki E. Comparison of caudal tramadol versus caudal fentanyl with bupivacaine for prolongation of postoperative analgesia in pediatric patients. *Saudi J Anaesth.* 2016;10:154-60.

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