

A comparison between 0.25% bupivacaine and 0.25% ropivacaine in caudal anaesthesia in paediatric patients undergoing lower abdominal surgeries

Darshana Kumbhre^{*1} and R. K. Jain²

¹Assistant Professor, Department of Anesthesiology, Government Medical College, Nagpur, Maharashtra, India

²Senior Deputy Director, Department of Anesthesiology, J. L. N. Hospital and Research Centre, Bhilai, Chhatisgarh, India

QR Code



***Correspondence Info:**

Dr. Darshana Kumbhre
Assistant Professor,
Department of Anesthesiology,
Government Medical College, Nagpur, Maharashtra, India

***Article History:**

Received: 23/11/2017

Revised: 26/11/2017

Accepted: 27/11/2017

DOI: <https://doi.org/10.7439/ijbr.v8i11.4490>

Abstract

Aims and Objectives: The present study was undertaken to compare the onset time, duration of action of sensory and motor blockade and postoperative pain relief between 0.25% bupivacaine and 0.25% ropivacaine in caudal block for children undergoing lower abdominal surgeries.

Method: In a double blind study, 50 patients of (age 2-8 years) ASA grade I and II were randomly allocated in two equal groups to received 0.75ml/ kg of either 0.25% bupivacaine (Group I) or 0.25% ropivacaine (Group II) via caudal epidural route. Caudal block was performed in all patients after induction of anesthesia with sevoflurane and oxygen. All the results were tabulated and analyzed statistically. For all statistical analysis, the level of significance was $P < 0.05$.

Results: There were statistically no significant difference between the groups, in respect of quality of sensory block and quality of motor block ($p > 0.05$). The duration of motor block in group 'I' was 142.2 ± 27.77 minutes while in group 'II' it was 120.6 ± 23.51 minutes ($p < 0.05$). The mean duration of pain relief was 241.76 ± 55.62 minutes in group 'I' compared with 238.2 ± 62.05 minutes in group 'II' ($p > 0.05$). The mean pain score of patients in both groups were comparable.

Conclusion: Bupivacaine and Ropivacaine provides almost similar duration of pain relief postoperatively but ropivacaine provides less motor blockade as compared to bupivacaine, making it a suitable agent for day care surgery with increase safety margin particularly in younger children.

Keywords: Caudal block, Ropivacaine, Bupivacaine, Sevoflurane, Sensory block, Motor block.

1. Introduction

Being unpleasant, pain is a subjective sensation, which in children can only be experienced and not expressed, because they depend on their care-givers for their well-being [1,2]. Despite an understanding of importance of adequate analgesia in adults, the treatment has frequently been only a secondary consideration in pediatric patients suffering from surgical pain. Fortunately recent studies have completely changed the approach to pediatric pain [3]. Post-operative pain relief in children is of paramount important since emotional component of pain is very strong in children. As pain is very difficult to assess in

pediatric population mostly, post-operative pain is undertreated in this age group [4].

Over the recent years, the concept of providing adequate post-operative analgesia in paediatric patients is well established, however, various methods showed side-effects limiting their use such as respiratory depression with IV opioids [5]. With a high success rate, caudal analgesia was proved to be a simple and effective technique in children. Caudal block is usually placed after the induction of general anaesthesia and is used as an adjunct to both intraoperative and postoperative analgesia in children

undergoing surgical procedures below the level of the umbilicus. It is one of the oldest and the most useful and popular paediatric regional block used today [6]. For caudal analgesia various local anaesthetics drugs like lignocaine, bupivacaine and ropivacaine have been used in different concentrations [7-11].

Both bupivacaine and ropivacaine are long-acting, amide local anesthetic with almost similar pKa (8.1). Ropivacaine, in comparison to bupivacaine blocks pain transmitting A-delta and C fibers to a greater degree than A-beta fibers controlling motor function [12,13]. It has a wider margin of safety, is less cardiotoxic and neurotoxic and similar duration of analgesia [14,15]. As compared with bupivacaine, ropivacaine undergoes lower systemic absorption from the caudal epidural space in children, so persists for longer duration [16]. To date, very few studies have been published comparing bupivacaine and ropivacaine for the caudal block in children. Therefore, present study was designed to compare the bupivacaine and ropivacaine in regards to duration of action of sensory and motor blockade, duration of pain relief and side effects.

2. Material and Method

The present randomized double blind prospective comparative study was carried out in the Department of Anaesthesiology at JLN Hospital and Research Centre, Bhilai. After obtaining institutional ethical committee approval and parent's written informed consent, the study was conducted in 50 pediatric patients, aged 2–8 years of ASA grade I and II, scheduled for lower abdominal surgeries. Paediatric patients with age <2 years or >8 years, ASA grade >II, with known allergy to either of drugs, infection at the site of block, history of bleeding diathesis, pre-existing neurological or spinal disease, abnormalities of sacrum and parent's refusal were excluded from the study. A detailed history and pre-anaesthetic evaluation including relevant laboratory investigations was done. All children were fasted for 6 hours before the procedure, however clear fluids were allowed 2 hours before procedure. The patients were randomly divided into two groups of 25 patients each to receive injection 0.25% bupivacaine (Group 'I') or injection 0.25% Ropivacaine (Group 'II') for caudal epidural block.

In the operation theatre, Cardioscope lead II, pulse oximeter and sphygmomanometer were attached to patient and baseline vital parameters e.g. Heart Rate (HR), Systolic blood pressure (SBP), Diastolic blood pressure (DBP), mean arterial pressure (MAP), SpO₂ and ECG rhythm were recorded. An intravenous line was established with a 24G intravenous cannula and IV ringer lactate was started. No premedication was administered. After pre-oxygenation

with 100% oxygen at rate of 6L/min for 3 min, patient was induced with 2.5% thiopentone sodium 5-7 mg/kg till eye lash reflex was lost. No sedatives or opioids were administered. All children were maintained on sevoflurane, nitrous oxide and oxygen inhalation with laryngeal mask airway of appropriate size. After induction of anaesthesia, caudal epidural block was given in left lateral position under all aseptic precautions with a hypodermic needle G-22. The placement of needle in caudal epidural space was confirmed by loss of resistance technique. The randomly allocated local anaesthetic drug was administered slowly in to the epidural space. Patient and principal investigator were blinded as to which group the patient was assigned. All patients were randomized to receive caudal epidural drugs with 0.75 ml/ kg of either 0.25% bupivacaine or 0.25% ropivacaine. Patient was immediately turned supine after injection of drug via caudal route.

Patients were monitored for heart rate, blood pressure, arterial oxygen saturation and EtCO₂ preoperatively, after induction, immediately after caudal block and at 5, 10, 15, 30, 45, 60 minutes after caudal block. Adequate intraoperative analgesia was defined by the absence of increase in heart rate and blood pressure >15% of baseline values just after surgical incision. All children received IV fluid in the form of ringer lactate as maintenance fluid. After surgery was completed all anaesthetics were discontinued. Laryngeal mask airway was removed and then patient was oxygenated till spontaneous eye opening. Duration of surgery was noted and any surgery which lasted for more than 60 minutes was excluded from the study. Later patient was shifted to recovery room and monitored for pulse rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and oxygen saturation. Postoperative pain was assessed by using "Pain Discomfort Scale" of Hanallah's [53] 1, 2, 4, 6, 8 hours respectively after surgery. Motor blockade was assessed by Modified Bromage Scale. Complications like hypotension, bradycardia, nausea, vomiting, fever, urinary retention and shivering were recorded.

2.1 Statistical Analysis

All the collected data were analyzed using student's unpaired t-test. A p value less than 0.05 were considered significant. The intergroup difference was measured at 95% confidence interval.

3. Observations and Results

Fifty children were enrolled in the study and divided into two groups of 25 children in each group. Both the groups were comparable with respect to age, weight, duration of anaesthesia, duration of surgery and which was statistically not significant. (Table 1)

Table 1: Shows demographic data of the patients and duration of surgery

Parameters	Group I	Group II	P value
Age (Years)	4.42±1.77	4.6±1.86	p>0.05, NS
Weight (Kg)	13.02±3.89	14.64±4.81	
Duration of Surgery (min)	46.8±10.89	46.2±11.39	

As shown in Figure 1-5, changes in haemodynamic parameters (HR, SBP, DBP and MAP) and changes in respiratory rate in both the groups were comparable and statistically insignificant ($P > 0.05$). Both the groups showed slight increased in all these parameters from baseline to caudal block then those parameters gradually decreased from 5 min after caudal block to 60 min intra-operatively but all values were within normal range and well maintained in all patients.

Figure 1: Comparison of Heart Rate

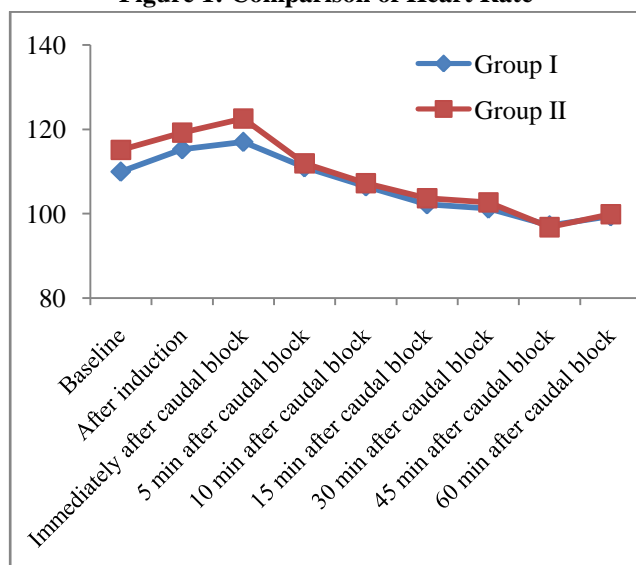


Figure 2: Comparison of SBP

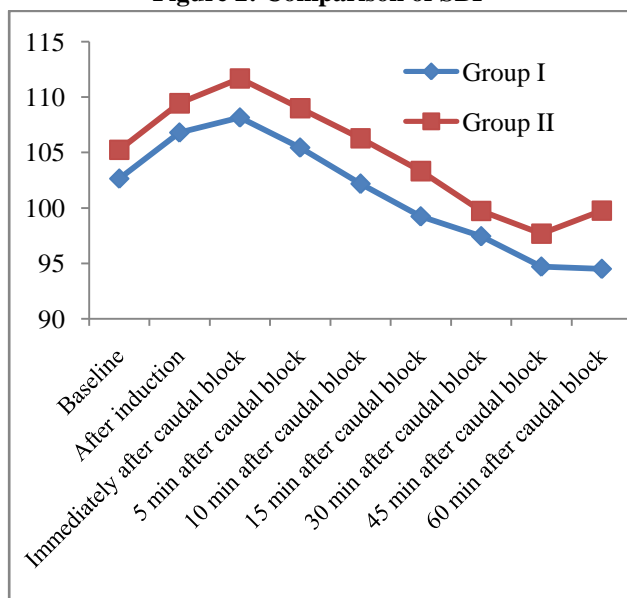


Figure 3: Comparison of DBP

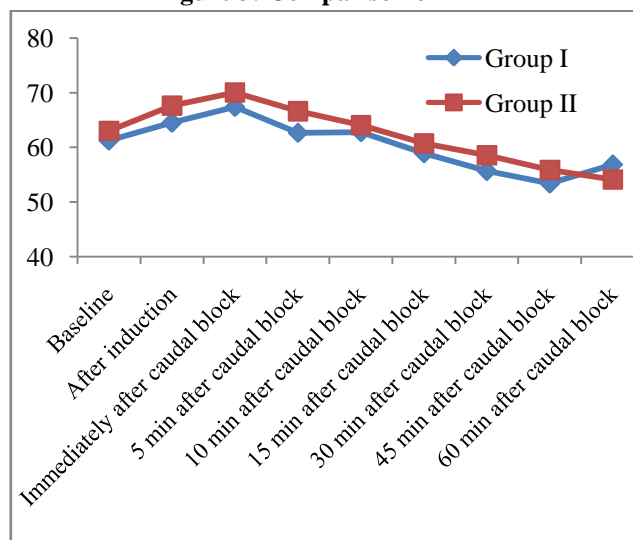


Figure 4: Comparison of MAP

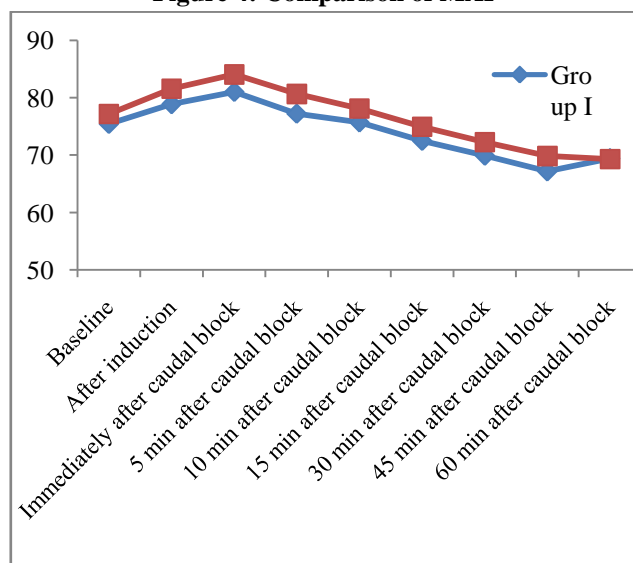
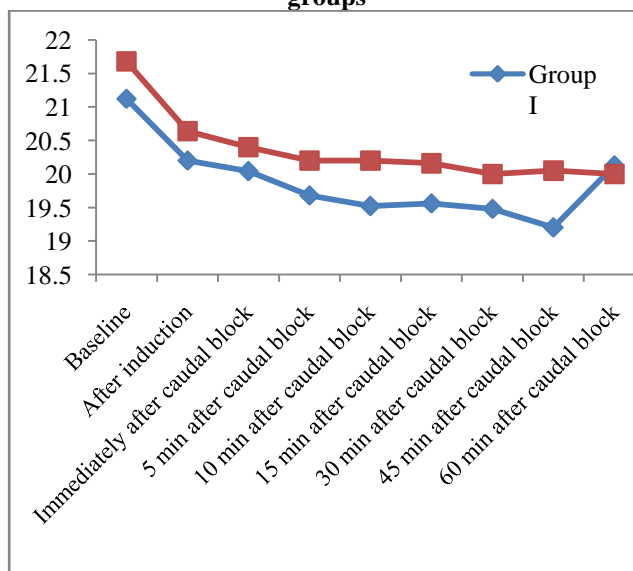


Figure 5: Comparison of Respiratory Rate between two groups



Postoperatively, the difference between pain scores in 1,2,4,6 and 8 hours was comparable between two groups. In the 1st hour postoperatively none of the patients in either of the group had any discomfort or pain (Table 2). So none of the patients required rescue analgesic within 1

hour of surgery. Motor weakness was present up to 2 hours postoperatively in most of the patients in both groups, thereafter there was no motor weakness seen in any of the patients. The difference between Modified Bromage Score in 1 and 2 hours was statistically significant, (Table 2).

Table 2: Hanallah Pain Discomfort Score and Modified Bromage Score in Both the Groups

Time (Hours)	Pain Discomfort Score		P value	Modified Bromage Score		P value
	Group I	Group II		Group I	Group II	
1	0	0	p>0.05	1.6±0.5	1.24±0.52	P<0.02
2	3.88±2.68	3.56±2.92		0.6±0.5	0.28±0.46	P<0.05
4	6.36±1.04	5.84±0.85		0	0	-
6	6.36±1.25	6.16±1.62		0	0	
8	6.8±1.5	7.12±1.59		0	0	

The mean duration of pain relief was 241.76±55.62 min for group I while it was 238.2±62.05 min for group II, which was statistically not significant. The mean duration of motor block was 142.2±27.77 min in group I and 120.6±23.51 min in group II and difference between two groups was statistically highly significant, (P<0.01). All the patients in both the group did not suffer from any complications postoperatively.

4. Discussion

Regional analgesia techniques are commonly used in paediatric patients for intraoperative analgesia and postoperative pain relief. Regional techniques are advantageous as there is little requirement of systemic narcotics and resumption of early feeding as well as early ambulation. For surgeries below umbilicus, caudal anaesthesia was the most commonly used procedure which was safe, simple and effective. It provides excellent analgesia during surgery as well as during postoperative period in lower abdominal surgeries in children [17-19]. Bupivacaine is commonly used local anesthetics for caudal anaesthesia with good success, while ropivacaine has been extensively used for regional anaesthesia in adults and children. In caudal block, the duration of analgesia depends on concentration and volume local anesthetics as well as the concentration of the adjuvant used. The volume of local anesthetic required in caudal block is directly proportional to the weight; larger volume of the drug increases the cephalad spread leading to higher levels of block [20]. In previous studies [8,21,22] bupivacaine and ropivacaine have been used for caudal anesthesia in 0.25% as optimal concentration and 0.75 ml/kg as optimum volume. Considering these studies [8,21,22] we too decided on same concentration and volume.

In present study, we compared an equal concentration (0.25%) of bupivacaine and ropivacaine for a single injection caudal anesthesia in children undergoing lower abdominal surgeries; the incidence and degree of the early postoperative motor blockade and postoperative analgesia were comparable between the two local anesthetic

agents. Thus, clinically, these two new local anesthetics appear almost similar when used at equal concentrations for the caudal blockade in children undergoing lower abdominal surgeries. Both the groups were homogenous with reference to age, weight and duration of anesthesia and duration of surgery and found no statistically significant difference between two groups. The maximum duration of surgery was 60 minutes; any surgery which lasted for more than 60 minutes was excluded. The intension behind not using premedication in this study was to avoid any false pain scoring due to sedation postoperatively.

Baseline haemodynamic parameters were comparable between two groups and found no statistically significant difference. There was slight increase in heart rate and blood pressure seen just after caudal block then gradually decreased to normal level. There was no increase in heart rate, systolic, diastolic and mean pressure after surgical incision was given and so all the caudal block were regarded clinically successful. However intraoperatively and postoperatively, no significant differences with respect to mean heart rate and blood pressure were noted between the groups. So, no patients required drug therapy to treat hypotension or bradycardia. All the caudal blocks were regarded as clinically successful because none of the children required additional analgesic doses during surgery. Our study correlated with the study of Da Conceicao MJ, Coelho *et al* [23].

Postoperative pain score, quality and duration of pain relief were comparable between two groups and found no statistically significant difference. This result was compared with study of Khalil *et al* [24]. The difference in duration of analgesia in our study was not statistically significant. Sensory block resolved completely by 241.76 min in group I and by 238.2 min in group II with statistically not significant variation. All the patients showed some amount of motor weakness in both groups, immediately after surgery. The difference in the mean duration of motor block among two groups was statistically highly significant. Also after two hours almost normal motor power was recorded in group II as compared to group

I and difference was statistically significant. These results were correlated with previous studies [23,25,26]. Our study was contradictory to that of Tan *et al* [27] which showed that there was no significant difference in degree of motor blockade between ropivacaine and bupivacaine on comparison in pediatrics caudal block.

Caudal anaesthesia with bupivacaine or ropivacaine in children is associated with a number of complications like hypotension, bradycardia, nausea and vomiting, respiratory depression and urinary retention but none of our patient suffered from any complications.

5. Conclusion

From the observations of the present study, it can be stated that, 0.75 ml/kg of caudal bupivacaine (0.25%) and 0.75 ml/kg ropivacaine (0.25%) provides effective postoperative analgesia in children and comparable with regards to their analgesic action. But ropivacaine given caudally provides less motor blockade as compared to bupivacaine, making it a suitable agent for day care surgery with increase safety margin particularly in younger children.

Acknowledgement

The authors wish to thank the Department of Anaesthesiology, surgery, other staff of operation theatre and administration of J. L.N. Hospital and Research Centre, Bhilai, Chhatisgarh, for permission to study and providing facility to carry out the work.

References

- [1]. Frank HK. The society of Paediatric Anaesthesia: 15th annual meeting, New Orleans, Louisiana. *Anaesthesia Analgesia*. 2002; 94:1661-8.
- [2]. Finley GA, Mc Granth PJ, Forward SP, *et al*. Parents management of children pain following "minor" surgery. *Pain*. 1996; 64:83-7.
- [3]. Kaushal D, Singh V, Abbas H, Mallik A, Singh G. Caudal bupivacaine-neostigmine for perioperative analgesia in pediatric patients undergoing infraumbilical surgeries: A prospective, randomized, double blind, controlled study. *The Internet J. Anesth*. 2008; (21)1.
- [4]. Laha A, Ghosh S, Das H. Comparison of caudal analgesia between ropivacaine and ropivacaine with clonidine in children: A randomized controlled trial. *Saudi J. Anesth*. 2012; 6: 197-200.
- [5]. Deng XM, Xiao WJ, Tang GZ, Luo MP, Xu KL. The minimum local anesthetic concentration of ropivacaine for caudal analgesia in children. *Anesth Analg*. 2002; 94:1465-8.
- [6]. Gehdoo RP. Post Operative Pain Management in Paediatric Patients. *Indian Journal of Anaesthesia*. 2004; 48: 406-411.
- [7]. Spiegel P. Caudal anaesthesia in pediatric surgery: a preliminary report. *Anaesthesia Analgesia*. 1962; 41: 218-221.
- [8]. Kay B. Caudal block for post-operative pain relief in children. *Anaesthesia*. 1974; 29: 610-611.
- [9]. Hassan SZ. Caudal anaesthesia in infants. *Anaesthesia Analgesia*. 1977; 56: 686-689.
- [10]. McGown RG. Caudal analgesia in children. Five hundred cases for procedures below the diaphragm. *Anaesthesia*. 1982; 37: 806-818.
- [11]. Pain terms: a list with definitions and notes on usage. Recommended by the IASP Subcommittee on Taxonomy. *Pain*. 1979; 6: 249.
- [12]. McClure JH. Ropivacaine. *Br J Anaesth* 1996; 76:300-7.
- [13]. McClellan KJ, Faulds D. Ropivacaine: An update of its use in regional anaesthesia. *Drugs* 2000; 60:1065-93.
- [14]. Scott DB, Lee A, Fagan D, Bowler GM, Bloomfield P, Lundh R. Acute toxicity of ropivacaine compared with that of bupivacaine. *Anesth Analg* 1989; 69:563-9.
- [15]. Ray M, Mondal SK, Biswas A. Caudal analgesia in paediatric patients: Comparison between bupivacaine and ropivacaine. *Indian J Anaesth* 2003; 47:275-8.
- [16]. Karmakar MK, Aun CS, Wong EL, Wong AS, Chan SK, Yeung CK. Ropivacaine undergoes slower systemic absorption from the caudal epidural space in children than bupivacaine. *Anesth Analg* 2002; 94:259-65.
- [17]. Choonara IA. Management of pain in newborn infants. *Semin. Perinatol* 1992; 16: 32-40.
- [18]. Markakis DA. Regional anaesthesia in pediatrics. *Anesth Clinics of North America*. 2000; 18: 355-381.
- [19]. Rowney DA, Doyle E. Epidural and subarachnoid blockade in children. *Anaesthesia* 1998; 58: 980-1001.
- [20]. Dalens B, Hasnaoui A. Caudal anesthesia in pediatric surgery: Success rate and adverse effects in 750 consecutive patients. *Anesth Analg* 1989; 68:83-9.
- [21]. Miller's Anesthesia, 7th Edition, page no. 1616-1618.
- [22]. Breschan C, Jost R *et al*. A prospective study comparing the analgesic efficacy of levobupivacaine, ropivacaine and bupivacaine in pediatric patients undergoing caudal blockade. *Pediatric Anesthesia* 2005; 15:301-306.
- [23]. Da Conceicao MJ, Coelho L. Caudal anesthesia with 0.375% ropivacaine or 0.375% bupivacaine in paediatric patients. *Br J Anaesth* 1998; 80:507-508.
- [24]. Khalil S, Campos C *et al*. Caudal block in children, ropivacaine compared with bupivacaine. *Anesthesiology* 1999; 91.
- [25]. Omar Elsafty MD, Ahmed MS *et al*. Comparative study of ropivacaine versus bupivacaine for pediatric caudal block. *The Egyptian Journal of Hospital Medicine* 2002; 8:88-93.
- [26]. Bramell RGB *et al*. Caudal block for postoperative epain relief in children. *Anesthesia* 1982; 37:1024-1028.
- [27]. Tan JS, Choo SM. Caudal ropivacaine versus bupivacaine for pediatric day case circumcision procedures. *The Internet of Anaesthesiology* 2004; 4(4).