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A COMPARATIVE STUDY BETWEEN ROPIVACAINE AND BUPIVACAINE IN PAEDIATRIC CAUDAL BLOCK FOR POST OPERATIVE ANALGESIA.

Anaesthesiology

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ABSTRACT

Introduction: This study looks at how well bupivacaine 0.25% and ropivacaine 0.2% work as painkillers after surgery in children who have had infraumbilical procedures. It shows how important regional analgesia is for controlling pain in children after surgery, even when opioids are needed. **Methods:** This prospective, randomised, comparative study was done at North Bengal Medical College and Hospital on 118 children between the ages of 2 and 8 who were having elective infraumbilical surgeries. The children were of either sex and had an ASA physical status of I or II. Group I is bupivacaine 0.25% (B), while Group II is ropivacaine 0.20% (R). Pain assessment using the Hannallah pain scale—all clinical data and initial rescue analgesic dosage were reported. **Results:** The study found that the R group had better pain relief and motor blockade after surgery, needed fewer painkillers, and didn't have any significant differences in side effects or dropout rates. **Conclusion:** Caudal block is a safe and effective way to relieve pain after surgery in children. Roprivacaine 0.20% gives longer pain relief with a shorter motor block and requires less rescue pain relief.

KEYWORDS

Ropivacaine, Bupivacaine, Paediatric Infraumbilical Surgeries Patients, Paediatric Anaesthesia, Postoperative Pain Control

INTRODUCTION

Pain, a complex, subjective experience, is a perceptual phenomenon with varying intensity, quality, and repercussions. The International Association for the Study of Pain (IASP) defines pain as an unpleasant sensory and emotional experience related to tissue damage [1].Pain during surgery from trauma raises catecholamines and catabolic hormones, which causes fast heart rate, high blood pressure, more work for the heart, and more oxygen use.

Because they know a lot about drugs, regional methods, and nociception neurobiology [2], anaesthesiologists play a big role in improving acute postoperative pain treatment. We need to treat acute postoperative pain aggressively, positioning it as the fifth vital sign [3]. Paediatric pain management is gaining popularity. Children's pain is still undertreated, even though it's as intense as adults' [4]. In this age range, unrelieved pain leads to bad neuroendocrine responses, changes in eating and sleeping patterns, and a stronger feeling of pain in future painful situations [5-7]. Numerous variables contribute to the undertreatment of children's pain. First, distinguishing pain-related crying or restlessness from hunger or fear is difficult. A lack of regular pain evaluation is a hindrance to acute pain treatment [8]. Children receive less pain medication because round-the-clock analgesics can lead to drowsiness and respiratory depression [9].

Over the past two decades, paediatric pain has been addressed through new pain scales and multimodal management. Pre-emptive analgesia prevents over-sensitivity to stimuli, while regional analgesia is preferred for postoperative pain treatment [10]. Caudal epidural is a common regional method for paediatric surgery and postoperative analgesia that reduces discomfort and ensures swift recovery. These blocks can cause sympathetic, sensory, and motor blocks, with few complications per 1000 operations [11].

Today's most prevalent long-acting local anaesthetics are bupivacaine and ropivacaine. Ropivacaine is better for children than bupivacaine because it is less harmful to the heart [12, 13, 14] and doesn't block nerve signals [15, 16]. It also gives the same amount of pain relief [17] at the same doses, making it a better caudal epidural analgesia agent [18]. It is possible for ropivacaine and bupivacaine to block sensory nerves during extradural and spinal anaesthesia [19]. However, ropivacaine has a shorter effect on motor nerves. In a study with 60 children, Da Conceicao MJ et al. found that caudal anaesthesia with Ropivacaine works well and causes less motor block after surgery than Bupivacaine [20]. In 1998, Ivani et al. looked at ropivacaine and bupivacaine for caudal analgesia in children. They found that ropivacaine was just as effective as bupivacaine, but it was safer because it was less toxic and had a lower drug mass [21].The study compared the effects of ropivacaine and bupivacaine on postoperative analgesia in paediatric caudal block patients. It found that both medications are safe and effective, with Ropivacaine allowing faster motor function recovery [22]. We aim to investigate the individual effects of each medication on postoperative analgesia in paediatric patients.

METHOD AND MATERIALS

The North Bengal Medical College & Hospital's ethics committee approved a prospective, randomised comparative research study from May 2021 to April 2022 that involved informed consent from participants. A trial was conducted on paediatric patients undergoing elective surgery in general surgery and orthopaedics, including children aged 3–6 with ASA physical status I and II. We didn't include people who had pilonidal cysts, spinal dysraphisms, blood dyscrasias, coagulopathies, allergies to local anaesthetics, or wouldn't sign a written consent form after being fully informed. The Armytage formula randomly assigned patients to either undergo the caudal block with 0.75 ml/kg of 0.20% ropivacaine or 0.25% bupivacaine. The study involved randomly inserting a computer-generated code in sealed envelopes and using Ratnani et al.'s research to determine the sample size of 118 paediatric patients.

A pre-anesthesia check-up, clinical history, physical examination, and routine investigations were all part of the study. Patients were chosen based on criteria for inclusion and exclusion, written informed consent was obtained, and they were given oral midazolam (0.5%) for 20 minutes to calm them down. We used standard monitors to track heart rate, mean atrial blood pressure, oxygen saturation, and respiratory rate. We used sevoflurane to make the patient sleepy, set up an intravenous peripheral channel, and infused isolyte P to keep them hydrated during the procedure. We placed the patient in the lateral or prone position and palpated the sacral hiatus. We advanced the needle at a 45-degree angle towards the patient's head until we felt a pop as it penetrated the sacrococcygeal ligament. We performed aspiration for blood and CSF, and if the results were negative, we proceeded with the injection. We slowly administered a dose of 0.75 ml/kg of either 0.25% bupivacaine (Group B) or 0.20% ropivacaine (Group R). An independent observer recorded blood pressure, heart rate, and pain score before and after surgery. We transferred the patients to the post-operative care unit (PACU) for 3 hours before moving them to the paediatric ward. We recorded pain scores at 15-minute intervals in the postoperative period up to 3 hours and conducted motor block assessments at 15-minute intervals. Statistical analysis was performed by SPSS version 22. Significance levels were denoted as $p \leq 0.05$.

Results

The study encompassed 118 children with lower limb injuries undergoing surgery, who received a caudal block for post-operative analgesia. Of these, 59 patients received ropivacaine (Group-R), while the remaining 59 patients received bupivacaine (Group-B). Table 1 documented the demographic data.

Table 1: Demographic Data of Ropivacaine (Group-R) versus Bupivacaine (Group-B) Group.

Characteristics	Group-R(n=59)	Group-B(n=59)	p-Value
Age (months)	53.86 ± 9.61	52.93 ± 10.15	0.350
Sex (M/F)*	55 (93.2%)/4 (6.8%)	53 (89.8%)/6 (10.2%)	0.509
Weight (Kg)	21.77 ± 4.46	20.63 ± 5.06	0.143
Height (cm)	103.78 ± 6.88	104.12 ± 7.41	0.969
BMI (Kg/m2)	19.98 ± 2.56	18.76 ± 3.15	0.068
ASA-PS(I/II)*	51 (86.4%)/8 (13.6%)	53 (89.8%)/6 (10.2%)	0.569
MAP	61.54 ± 5.71	63.42 ± 5.82	0.711
Heart Rate (per minute)	102.88 ± 9.37	100.92 ± 9.38	0.790
Respiratory Rate (per minute)	22.46 ± 4.31	21.76 ± 4.25	0.732
SpO2 (%)	99.51 ± 0.97	99.49 ± 1.04	0.726
Mean duration of Surgery	41.69 ± 9.57	38.03 ± 9.71	0.657
Mean duration of Anaesthesia	54.64 ± 9.4	51.28 ± 9.69	0.618
Mean time (Minutes) for First recorded analgesia	416.95	412.37	0.000
Mean time (Minutes) for Complete Sensory Recovery	84.66	81.61	0.061
Mean time (Minutes) for Complete Motor Recovery	197.03	266.69	0.000
Adverse effect (Nausea & Vomiting)	4 (6.7%)	6 (10.16%)	0.059
Adverse effect (Retention of Urine)	0 (0%)	1 (1.69%)	0.315

We found that there are no statistically significant differences between the groups in respect to patients's age, height, weight, BMI, ASA class, and sex distribution. The patient's heart rate, respiratory rate, and SpO_2 did not significantly differ. The mean duration of surgery and anesthesia were almost identical in both groups. It's intriguing that there wasn't a big difference between the Bupivacaine and Ropivacaine groups when we looked at the average time (in minutes) for the first recorded pain relief and full sensory recovery after caudal blocks. However, patients who received Ropivacaine showed much faster full motor recovery. Patients in the Bupivacaine and Ropivacaine groups did not experience any significant adverse effects during caudal blocks. Table 2 shows that there were no statistically significant differences in the mean intraoperative MAP among paediatric patients who had a caudal block with ropivacaine or bupropion.

Table 2: Comparison of Mean Intra-Operative MAP in Peadiatric Patients Following Caudal Block using Ropivacaine (Group-R) Versus Bupivacaine (Group-B)

MAP	Group-R (n=59)	Group-B(n=59)	p-Value
Baseline	61.54 ± 5.71	63.42 ± 5.82	0.711
Before incision	58.88±5.68	60.46±5.73	0.445
Immediately after incision	58.14±5.55	59.83±5.85	0.894
5 Minutes after incision	57.92±5.32	59.59±5.87	0.893
10 Minutes after incision	55.88±5.29	57.49±5.86	0.939
15 Minutes after incision	56.08±5.11	58.24±6.20	0.265
30 Minutes after incision	55.93±5.09	58.74±5.89	0.446
45 Minutes after incision	54.44±4.80	59.2±6.23	0.256
60 Minutes after incision	55.50±5.64	59.15±6.26	0.548

We also didn't find any statistically significant differences in the average heart rate during surgery in children who had a caudal block with ropivacaine and bupivacaine (Table 3).

Table 3: Comparison of Mean Intra-Op Heart Rate in Peadiatric Patients Following Caudal Block Using Ropivacaine (Group-R) Versus Bupivacaine (Group-B)

HR	Group-R (n=59)	Group-B(n=59)	p-Value
Baseline	102.88 ± 9.37	100.92 ± 9.38	0.790
Before incision	100.95±9.39	98.51±9.24	0.651
Immediately after incision	108.02±9.08	105.12±9.22	0.878
5 Minutes after incision	108.83±9.05	105.59±8.92	0.760
10 Minutes after incision	105.78±8.98	102.32±9.09	0.959
15 Minutes after incision	106.95±8.84	103.83±9.15	0.904
30 Minutes after incision	106.17±8.64	102.59±9.01	0.875
45 Minutes after incision	102.67±9.10	99.73±8.57	0.475
60 Minutes after incision	103±8.81	97.31±5.12	0.083

There are statistically significant differences found between the groups with respect to the patient's mean postoperative analgesia recovery. We observe that ropivacaine significantly prolongs the duration of postoperative analgesia (Table 4).

Table 4: Comparison of Mean Post-Op Sensory Recovery Using Hannallah Pain Scale in Peadiatric Patients Following Caudal Block Using Ropivacaine (Group-R) Versus Bupivacaine (Group-B)

Mean Post-Op sensory recovery	Group-R (n=59)	Group-B (n=59)	p-Value
15 minutes after induction	0.27±0.45	0.29±0.46	0.685
30 minutes after induction	0.42±0.5	0.46±0.5	0.480
45 minutes after induction	0.56±0.5	0.59±0.5	0.471
60 minutes after induction	1.03±0.32	1.1±0.36	0.124
75 minutes after induction	1.05±0.34	1.14±0.35	0.154
90 minutes after induction	1.07±0.37	1.15±0.36	0.188
105 minutes after induction	1.1±0.4	1.19±0.39	0.257
120 minutes after induction	1.14±0.43	1.22±0.42	0.327
135 minutes after induction	1.15±0.45	1.25±0.44	0.206
150 minutes after induction	1.15±0.45	1.27±0.45	0.108
165 minutes after induction	1.17±0.46	1.29±0.46	0.131
180 minutes after induction	1.25±0.44	1.32±0.47	0.109
210 minutes after induction	1.27±0.45	1.34±0.48	0.116
240 minutes after induction	1.29±0.46	1.36±0.48	0.123
270 minutes after induction	1.32±0.47	1.41±0.5	0.680
300 minutes after induction	1.36±0.52	1.56±0.68	0.004
330 minutes after induction	1.54±0.54	1.92±0.53	0.002
360 minutes after induction	1.92±0.53	2.23±0.43	0.734
390 minutes after induction	2.48±0.68	3.07±0.67	0.100
420 minutes after induction	4±0	4±0	NA
450 minutes after induction	NA	NA	NA
480 minutes after induction	NA	NA	NA

The study compared patients using a cold cotton touch for postoperative sensory recovery, but no significant differences were found between the Ropivacaine and Bupivacaine groups (the data is not displayed here). For mean post-operative motor recovery, we were using the Bromage scale, and we found that the mean postoperative motor recovery time of the ropivacaine group is less than the bupivacaine group (Table 5).

Table 5: Comparison of Mean Post-Op Motor Recovery Using Bromage Scale in Peadiatric Patients Following Caudal Block Using Ropivacaine (Group-R) Versus Bupivacaine (Group-B) (in percentage):

Minutes after Caudal block	Group-R (n=59)				Group-B (n=59)				p-Value
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 1	Grade 2	Grade 3	Grade 4	
15	0 (0%)	0 (0%)	0 (0%)	59(100%)	0 (0%)	0 (0%)	0 (0%)	59 (100%)	NA
30	0 (0%)	0 (0%)	0 (0%)	59(100%)	0 (0%)	0 (0%)	0 (0%)	59(100%)	NA
60	0 (0%)	0 (0%)	0 (0%)	59(100%)	0 (0%)	0 (0%)	0 (0%)	59(100%)	NA
75	0 (0%)	0 (0%)	0 (0%)	59(100%)	0 (0%)	0 (0%)	0 (0%)	59(100%)	NA
90	0 (0%)	0 (0%)	16 (27.1%)	43 (72.9%)	0 (0%)	0 (0%)	1 (1.7%)	58 (98.3%)	0.000
105	0 (0%)	0 (0%)	20 (33.9%)	39 (66.1%)	0 (0%)	0 (0%)	4 (6.8%)	55 (93.2%)	0.000
120	0 (0%)	0 (0%)	26 (44.1%)	33 (55.9%)	0 (0%)	0 (0%)	9 (15.3%)	50 (84.7%)	0.001
135	17 (28.8%)	17 (28.8%)	29 (49.2%)	13 (22%)	0 (0%)	4 (6.8%)	19 (32.2%)	36 (61%)	0.000
150	28 (47.5%)	28 (47.5%)	20 (33.9%)	5 (8.5%)	1 (1.7%)	9 (15.3%)	19 (32.2%)	30 (50.8%)	0.000
165	27 (45.8%)	27 (45.8%)	15 (25.4%)	1 (1.7%)	2 (3.4%)	19 (32.2%)	13 (22%)	25 (42.4%)	0.000
180	22 (37.3%)	22 (37.3%)	4 (6.8%)	0 (0%)	9 (15.3%)	21 (35.6%)	9 (15.3%)	20 (33.9%)	0.000
210	12 (20.3%)	12 (20.3%)	0 (0%)	0 (0%)	17 (28.8%)	14 (23.7%)	12 (20.3%)	16 (27.1%)	0.000
240	5 (8.5%)	5 (8.5%)	0 (0%)	0 (0%)	23 (39%)	20 (33.9%)	10 (16.9%)	6 (10.2%)	0.000
270	1 (1.7%)	1 (1.7%)	0 (0%)	0 (0%)	35 (59.3%)	18 (30.5%)	6 (10.2%)	0 (0%)	0.000
300	0 (0%)	0 (0%)	0 (0%)	0 (0%)	46 (78%)	12 (20.3%)	1 (1.7%)	0 (0%)	0.001
330	0 (0%)	0 (0%)	0 (0%)	0 (0%)	54 (91.5%)	5 (8.5%)	0 (0%)	0 (0%)	0.022
360	0 (0%)	0 (0%)	0 (0%)	0 (0%)	58 (98.3%)	1 (1.7%)	0 (0%)	0 (0%)	0.315
390	0 (0%)	0 (0%)	0 (0%)	0 (0%)	59 (100%)	0 (0%)	0 (0%)	0 (0%)	NA
420	0 (0%)	0 (0%)	0 (0%)	0 (0%)	59 (100%)	0 (0%)	0 (0%)	0 (0%)	NA
450	0 (0%)	0 (0%)	0 (0%)	0 (0%)	59 (100%)	0 (0%)	0 (0%)	0 (0%)	NA
480	0 (0%)	0 (0%)	0 (0%)	0 (0%)	59 (100%)	0 (0%)	0 (0%)	0 (0%)	NA

DISCUSSION

Postoperative pain is a major concern for both adults and paediatric patients. Controlling it is crucial for medical researchers and practitioners. Regional anesthesia techniques like caudal epidural have gained acceptance due to safety. Bupivacaine and ropivacaine have emerged as safer options for pain relief. A study found that ropivacaine gives longer pain relief with less need for additional painkillers but shorter motor blockade duration.

The study compared two child groups based on demographics, surgery duration, and anesthesia duration, finding no significant differences in age, body weight, or sex distribution. In 1998, Da Conceicao MJ and Coelho L reported a significant difference in motor block at 2, 3, and 4 hours following surgery (p = 0.016) [18]. In 1999, Da Conceicao MJ, Coelho L, and Khalil M looked at ropivacaine 0.25% and bupivacaine 0.25% through the caudal route again. They discovered that the ropivacaine group had a motor block duration that was much shorter [23]. Khalil S et al. also found substantial motor block, which virtually recovered to normal power after three hours in the ropivacaine group but was much slower in the bupivacaine group [24]. Another trial found that ropivacaine, but not levo-bupivacaine, caused significantly less motor block in the first postoperative hour than racemic bupivacaine [25]. Negri et al. (2004) and Locatelli B et al. (2005) looked at how well bupivacaine reduced motor blockade in kids who had hypospadias repair and found that it did [26, 27].

The study looked at how different groups of people recovered from surgery using cold cotton contact. It found that patients in Group R had longer sensory blocks and delayed rescue analgesia than patients in Group B. [28]. For paediatric caudal blocking, bupivacaine had a shorter mean time to initial analgesia than ropivacaine [29]. The average length of pain relief after surgery was a little longer in the ropivacaine group, but it wasn't statistically significant [30]. The study used 42 children and either 1 ml/kg bupivacaine 0.25% or 1 ml/kg ropivacaine 0.25% for caudal block during inguinal hernia repair. Another study found that caudal 0.25% bupivacaine combined with 0.25% ropivacaine had a shorter average analgesia duration [31]. It was done by Da Conceicao MJ et al. in 1998 to compare the motor block of ropivacaine and bupivacaine. They discovered that the caudal route had the same level of sensory block and analgesia [18]. Khalil S. et al. did a double-blind study in 1999 that looked at caudal bupivacaine and ropivacaine, both 0.25% and 1 ml/kg [24]. They found that ropivacaine produced acceptable postoperative analgesia, matching bupivacaine in quality and duration. In a 2000 study of 42 children undergoing inguinal hernia repair, Brescham C. Whit et al. found that ropivacaine had similar analgesic effects on paediatric caudal blocks as bupivacaine [30]. In a study from 2005, Locatelli B et al. discovered that bupivacaine, caudal levobupivacaine, and ropivacaine all worked about the same as painkillers during surgery below the umbilical cord [27].

This research discovered that caudal ropivacaine works as well as bupivacaine at relieving pain, but the effects last for different amounts of time after surgery. It delivered an efficient caudal block with longer duration and a shorter motor block for paediatric infraumbilical procedures with no major adverse effects. The limited sample size of our research necessitates further trials to confirm stronger relationships. The study compared caudal bupivacaine and ropivacaine for pain relief in children post-surgery. Results showed ropivacaine provided longer pain relief with less painkilling effect and less residual motor blockade than bupivacaine, despite potential hospital bias. So, ropivacaine has an equal amount of pain-relieving and motor nerve-blocking effects, which means that the motor block lasts less time. Ropivacaine is increasingly being considered as a safer and more effective alternative to bupivacaine for caudal paediatric postoperative pain treatment due to its superior separation of sensory and motor functions.

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