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Original Article

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A Comparative Study Between Ropivacaine and Bupivacaine in Pediatric Caudal Block for Postoperative Analgesia

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Abstract

Background: Advancements in pediatric anesthesia and pain management have made pediatric surgery safer. Caudal epidural analgesia is a common postoperative technique in children, offering benefits over general anesthesia alone. This study compared the analgesic efficacy of caudal 0.25% bupivacaine and 0.25% ropivacaine for postoperative pain management in infra-umbilical pediatric surgeries. ***Methods:*** A prospective, randomized study was conducted on 60 ASA I-II children (3-6 years) undergoing elective infraumbilical surgery at Sardar Vallabhbhai Patel Post Graduate Institute of Paediatrics (SVPPGI), Cuttack (2023-2024). Patients received either 0.75mg/kg of caudal 0.25% bupivacaine (Group B) or ropivacaine (Group R). Postoperative pain (Hannallah scale), time to first rescue analgesic, total analgesic consumption, motor blockade duration (Bromage), hemodynamics, SpO2, and adverse effects were recorded and analyzed. ***Results:*** Both groups were comparable. The ropivacaine group experienced significantly longer postoperative analgesia and a shorter duration of motor blockade compared to the bupivacaine group. Sensory recovery time and hemodynamic stability were similar between groups. No significant differences in side effects or dropouts were observed. ***Conclusion:*** Caudal 0.25% ropivacaine provides significantly longer postoperative analgesia and faster motor recovery than 0.25% bupivacaine in pediatric patients. Ropivacaine is an equipotent analgesic with reduced motor blockade, potentially enabling earlier ambulation and serving as a safe and effective alternative for pediatric caudal postoperative pain management.

Keywords: ***Ropivacaine, Pediatrics, Bupivacaine, Motor Block, Pain.***

Introduction

Pain, a complex and subjective experience with varying dimensions, has troubled humans throughout history. The International Association for the Study of Pain (IASP) defines it as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage [1].

Surgical trauma triggers a stress response involving hormonal changes that lead to tachycardia, hypertension, and increased cardiac workload, highlighting the critical need for perioperative pain management [2]. Anesthesiologists leverage their knowledge of pharmacology, regional techniques, and nociception to advance postoperative pain care. Recognizing its importance, pain is considered the fifth vital sign [3]. While pain management in children is gaining recognition, it remains frequently undertreated despite comparable pain intensity to adults. Untreated pain in children can cause harmful neuroendocrine responses, disrupt sleep and eating, and increase future pain sensitivity [4-7].

Pediatric pain under treatment stems from challenges in distinguishing pain from other distress, inconsistent pain assessment, and concerns about sedation/respiratory depression with scheduled analgesics, leading to lower medication administration despite pain intensity [8,9].

Pediatric pain management has gained significant focus in the last two decades, with the development of pain scales enhancing assessment and treatment. A multimodal approach is key for managing acute postoperative pain in children. Preemptive analgesia, initiating interventions along the pain pathway before noxious stimuli, aims to prevent central sensitization and subsequent pain amplification.

Parenteral analgesics frequently cause adverse effects. Given the difficulty pediatric patients have in articulating their pain, regional analgesia is a favored postoperative pain management strategy in this population [10]. Neuraxial blocks, with minimal hemodynamic impact, are particularly well-tolerated in young children.

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Caudal epidural, a prevalent regional anesthetic technique in pediatrics, offers both intra- and postoperative analgesia. Its ease of administration and established safety profile contribute to its widespread use. Compared to general anesthesia alone, caudal blocks yield reduced postoperative pain scores and, when combined with general anesthesia, can decrease the need for volatile agents and opioids, facilitating rapid, less painful recovery with fewer emetic episodes, earlier oral intake, and potentially earlier discharge.

Caudal epidural blocks induce sympathetic, sensory, and motor blockade with effects varying by local anesthetic volume, dose, and concentration. Rare (≈1/1000) and typically minor complications may occur [11]. Ropivacaine, a long-acting local anesthetic, exhibits reduced cardiotoxicity and motor blockade compared to bupivacaine at equianalgesic doses, making it a favored agent for pediatric caudal epidural analgesia [12]. Study reported equipotent sensory blockade but shorter motor blockade with ropivacaine versus bupivacaine in extradural and spinal anesthesia[13].

Studies by Da Conceicao *et al.* [14] in 60 children and Ivani *et al.* [15] in 245 children undergoing minor surgeries indicate that caudal ropivacaine provides effective postoperative analgesia with reduced motor blockade compared to bupivacaine, potentially offering a greater safety margin due to lower toxicity and required mass.

Prior research indicated comparable safety and analgesic efficacy of caudal bupivacaine and ropivacaine in pediatric urogenital surgery, with earlier motor recovery in the ropivacaine group, suggesting its potential as a superior alternative for prolonged analgesia [16]. However, limited data directly compares these agents for postoperative analgesia and motor block recovery specifically in pediatric caudal anesthesia. Therefore, this study aimed to compare the duration of postoperative analgesia following caudal ropivacaine versus bupivacaine in children, hypothesizing that ropivacaine will provide longer-lasting analgesia.

Methodology

Study design: This prospective, randomized, comparative study was conducted in the Pediatric Surgery Department at SVPPGI, Cuttack, Odisha, from 2023 to 2024, following institutional ethics committee approval (SCB Medical College). Pediatric patients undergoing elective surgery (<1 hour duration) were enrolled based on predefined inclusion/exclusion criteria, with data collection spanning from 30 minutes preoperatively to 24 hours postoperatively.

Inclusion criteria

- American Society of Anaesthesiologists (ASA) physical status I and II
- Age: 3 yrs to 6 yrs

Exclusion Criteria

- Patients whose parents were unwilling to execute informed written
- Consent
- Infection at the proposed site of block
- Known case of or suspected cases of, or family history of blood
- Dyscrasias and coagulopathies History of allergy to local anaesthetics
- Pilonidal cyst
- Spinal dysraphisms

Based on a prior study (Leghari *et al.*) and statistical power analysis (α=0.05, power=0.80), a minimum sample size of 29 per group was determined. Sixty pediatric patients were subsequently randomized (1:1) using computer-generated codes in sealed envelopes to receive either 0.75 mg/kg of 0.25% ropivacaine or 0.75 mg/kg of 0.25% bupivacaine via caudal block (total volume 1 ml/kg).

Study Technique

Following institutional ethics board approval and informed parental consent, 60 ASA I-II pediatric patients (3-6 years) scheduled for <1-hour elective infraumbilical/pelvic surgery at SVPPGI, Cuttack, were prospectively randomized into two groups (n=30 each) to receive caudal epidural 0.25% bupivacaine (0.75mg/kg) or 0.25% ropivacaine (0.75mg/kg) for postoperative analgesia. Standard general anesthesia was administered. An independent observer, blinded to the study drug, recorded perioperative hemodynamic parameters. Postoperatively in the PACU and ward, pain (Hannallah scale), time to first rescue analgesic (IV paracetamol 15mg/kg for score ≥4), sensory recovery (cold cotton touch), and motor recovery (modified Bromage scale) were assessed at defined intervals. Data were statistically analyzed.

Study variables

- Complete recovery of sensory block by cold cotton touch
- Complete recovery of motor block by modified Bromage scale 8
- Duration of requirement of first rescue analgesia
- Pain score at 15 mins interval in post-operative period up to 3 hours via Hannallah pain scale2 and then 30 mins interval for next 5 hrs.
- Assessment of motor block by modified Bromage scale at 15 mins interval in post- operative period up to 3 hours and every 30 mins interval for next 5 hours.

Outcome definition and parameters

This study scientifically compared the duration until the first rescue analgesic was required (administered intravenously at 15 mg/ml for a pain score >4) between Group R and Group B. Analgesic efficacy was assessed using a pain scale every 15 minutes for the first 3 hours and then every 30 minutes for the subsequent 5 hours. Sensory recovery (cold cotton touch) and motor recovery (modified Bromage scale) were evaluated at the same intervals. Postoperative adverse effects were also recorded in both groups.

Ethical consideration

The Institutional Ethics Committee of SCB Medical College & Hospital, Cuttack, approved the study protocol. Prior to data collection via researcher-administered questionnaires, all participants provided informed consent, having received comprehensive information regarding the study's objectives, their rights (including voluntary participation, confidentiality, and withdrawal), and data handling procedures. Collected data were subsequently cleaned, anonymized, and securely stored in a password-protected spreadsheet for analysis.

Data analysis

The collected data underwent quality checks and were entered into a Microsoft Excel database. Statistical analysis was performed using IBM SPSS (trial version), employing descriptive and inferential statistics. Categorical data are presented as proportions, and continuous data as mean±SD. A p-value < 0.05 was considered statistically significant.

Results

This study included 60 children undergoing infraumbilical surgery who received caudal analgesia, with 30 patients randomized to ropivacaine (Group R, mean age 55.68±8.21 months, 83.3% male, mean weight 22.65±5.58 kg, mean height 102.76±5.68 cm, mean BMI 19.73±2.33) and 30 to bupivacaine (Group B, mean age 54.73±9.18 months, 76.7% male, mean weight 23.59±5.34 kg, mean height 104.64±6.44 cm, mean BMI 18.76±3.34).

Table 1: Demographic Data

Characteristics	Group-R (n=30)	Group-B (n=30)	p-Value
Age (months)	55.68±8.21	54.73±9.18	0.67
Sex			
Male	25(83.3)	23(76.7)	
Female	5(16.7)	7(23.3)	0.745
Weight (Kg)	22.65±5.58	23.59±5.34	0.51
Heigh t(cm)	102.76±5.68	104.64±6.44	0.23
BMI (Kg/m2)	19.73±2.33	18.76±3.34	0.19
ASA-PS (I/II)*			
I	26(86.7)	27(90.0)	
II	4(13.3)	3(10.0)	0.370

Table 2: Mean Baseline Characteristics of the participants

Characteristics	Group-R (n=30)	Group-B (n=30)	p-Value
MAP	63.64±6.51	65.71±8.19	0.28
Heart Rate (per minute)	104.78±8.33	102.94±9.24	0.42
Sp02	99.71±1.02	99.53±1.06	0.50

Table 3: Mean duration of Surgery and mean duration of Anaesthesia (minutes)

Characteristics	Group-R (n=30)	Group-B (n=30)	p-Value
Mean duration of Surgery	42.81±9.73	39.52±8.96	0.17
Mean duration of Anaesthesia	55.53±8.7	52.48±9.12	0.19

Table 4: Comparison of Mean Intra-Operative MAP in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine.

MAP	Group-R (n=30)	Group-B (n=30)	p-Value
Baseline	62.72±5.91	64.03±6.01	0.39
Before incision	59.27±5.74	61.17±5.87	0.21
Immediately after incision	59.02±5.62	60.34±5.91	0.38
Five minutes after Incision	58.57±5.31	60.17±5.95	0.27
Ten minutes after Incision	56.72±5.26	58.92±5.93	0.13
Fifteen minutes after Incision	57.31±5.13	59.29±5.24	0.18
Thirty minutes after Incision	56.16±5.06	58.87±5.18	0.23
Forty-five minutes after Incision	55.35±4.89	57.11±5.21	0.18
Sixty minutes after incision	56.59±5.21	58.27±5.29	0.16
Seventy-five minutes after Incision	NA	NA	NA
Ninety minutes after Incision	NA	NA	NA

Table 5: Comparison of Mean Intra-Op Heart Rate in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine.

Heart Rate	Group-R(n=30)	Group-B(n=30)	p-Value
Baseline	103.72±9.74	101.86±9.69	0.46
Before incision	101.54±9.78	99.53±9.61	0.42
Immediately after incision	109.01±9.52	106.13±9.57	0.24
Five minutes after Incision	109.91±9.54	106.59±9.01	0.17
Ten minutes after Incision	106.33±8.98	103.47±9.43	0.23
Fifteen minutes after Incision	107.94±8.51	104.76±9.72	0.26
Thirty minutes after Incision	107.43±8.49	103.51±9.37	0.09
Forty five minutes after Incision	103.39±8.98	100.79±8.95	0.27
Sixty minutes after incision	103.98±8.84	98.12±5.13	0.08
Seventy five minutes after Incision	NA	NA	NA
Ninety minutes after Incision	NA	NA	NA

Table 6: Comparison of Mean Post-Op analgesia recovery using Hannallah pain scale in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine

Analgesia recovery	Group-R	Group-B	p-Value
15 minutes after incision	0.32 ± 0.41	0.35 ± 0.43	0.78
30 minutes after incision	0.51 ± 0.47	0.56 ± 0.45	0.67
45 minutes after incision	0.63 ± 0.50	0.65 ± 0.51	0.87
60 minutes after incision	1.13 ± 0.36	1.23 ± 0.39	0.30
75 minutes after incision	1.17 ± 0.34	1.29 ± 0.41	0.22
90 minutes after incision	1.19 ± 0.30	1.30 ± 0.32	0.17
105 minutes after incision	1.22 ± 0.41	1.34 ± 0.39	0.25
120 minutes after incision	1.26 ± 0.45	1.37 ± 0.42	0.33
135 minutes after incision	1.27 ± 0.47	1.41 ± 0.43	0.23
150 minutes after incision	1.28 ± 0.47	1.43 ± 0.44	0.20
165 minutes after incision	1.31 ± 0.46	1.45 ± 0.46	0.24
180 minutes after incision	1.37 ± 0.44	1.47 ± 0.47	0.39
210 minutes after incision	1.39 ± 0.43	1.48 ± 0.45	0.43
240 minutes after incision	1.41 ± 0.47	1.51 ± 0.45	0.40
270 minutes after incision	1.43 ± 0.48	1.57 ± 0.49	0.26
300 minutes after incision	1.47 ± 0.51	1.73 ± 0.63	0.08
330 minutes after incision	1.61 ± 0.53	2.01 ± 0.51	0.004
360 minutes after incision	2.02 ± 0.51	2.73 ± 0.39	0.0001
390 minutes after incision	2.83 ± 0.52	3.27 ± 0.61	0.004
420 minutes after incision	NA	NA	NA
450 minutes after incision	NA	NA	NA
480 minutes after incision	NA	NA	NA

Mean Post-Op analgesia recovery using Hannallah pain scale in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine was statistically differ 330 Minutes,360 mints & 390 mints after incision (Table 7).

Table7: Comparison of Mean Post-Op sensory recovery using Cold cotton touch in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine.

Complete Sensory Recovery Time	Frequency	Percentage
45	4	6.7
60	9	15
75	18	30
90	13	21.7
105	8	13.3
102	6	10
135	2	3.3
Total	60	100

Mean Post-Op sensory recovery using Cold cotton touch in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine was maximum at 75 mints followed by 90 mints (Table 8).

Table 8: Comparison of Mean Post-Op motor recovery using Bromage scale in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine (in %)

Minutes after Caudal block	Group-R (n=30)				Group-B (n=30)			
	Grade4	Grade3	Grade2	Grade1	Grade4	Grade3	Grade2	Grade1
15	30 (100)	0	0	0	30(100)	0	0	0
30	30 (100)	0	0	0	30(100)	0	0	0
60	30(100)	0	0	0	30(100)	0	0	0
75	30(100)	0	0	0	30(100)	0	0	0
90	22(73.3)	8(26.7)	0	0	29(96.7)	1(3.3)	0	0
105	19(63.3)	11(36.7)	0	0	27(90)	3(10)	0	0
120	16(53.3)	14(46.7)	0	0	24(80)	6(20)	0	0
135	7(23.3)	15(50)	8(26.7)	0	19(63.3)	9(30)	2(6.7)	0
150	3(10)	11(36.7)	14(46.6)	2(6.7)	16(53.4)	9(30)	4(13.3)	1(3.3)
165	1(3.3)	8(26.7)	13(43.3)	8(26.7)	13(43.3)	7(23.3)	8(26.7)	2(6.7)
180	0	2(6.7)	11(36.7)	17(56.6)	12(40)	4(13.3)	10(33.3)	4(13.3)
210	0	0	6(20)	24(80)	9(30)	5(16.7)	7(23.3)	9(30)
240	0	0	3(10)	27(90)	3(10)	4(13.3)	10(33.3)	13(43.3)

270	0	0	1(3.3)	29(96.7)	0	3(10)	8(26.7)	19(63.3)
300	0	0	0	30(100)	0	1(3.3)	5(16.7)	15(50)
330	0	0	0	30(100)	0	0	2(6.7)	28(93.3)
360	0	0	0	30(100)	0	0	1(3.3)	29((96.7))
390	0	0	0	30(100)	0	0	0	30(100)
420	0	0	0	30(100)	0	0	0	30(100)
450	0	0	0	30(100)	0	0	0	30(100)
480	0	0	0	30(100)	0	0	0	30(100)

Table 9: Comparison of Mean time (Minutes) for First recorded analgesia,complete sensory recovery and complete motor recovery in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine.

Comparison of Mean time	Group-R	Group-B	p-Value
First Recorded Analgesia	418.12 ± 9.13	412.17 ± 12.46	0.000
Complete Sensory Recovery	85.29 ± 32.46	81.03 ± 29.28	0.073
Complete Motor Recovery	198.72 ± 51.79	267.59 ± 66.43	0.0001

Table 10: Comparison of Mean Post-Op Sensory recovery using Cold cotton touch in peadiatric patients following caudal block using Ropivacaine versus Bupivacaine.

Cold cotton touch	Group-R	Group-B	p-Value
Mean Post-OP complete sensory Recovery time	83.58 ± 20.78	80.67 ± 16.34	0.319

Nausea vomiting was found to be most common adverse effect in both the groups followed by vein puncture whereas urinary retention was found to be present only in 1 case of group B.

Table 11: Comparison Adverse effects between two groups in peadiatricpatients following caudal block using Ropivacaine versus Bupivacaine.

Groups	Nausea Vomiting	Artery Puncture	Vein Puncture	Nerve Injury	Retention of Urine	Infection
Group R(%)	2 (6.67)	0	1(3.3)	0	0	0
Group B (%)	4 (13.3)	0	0	0	1(3.3)	0

Discussion

Postoperative pain in children, comparable to adults, triggers adverse physiological responses via increased sympathetic activity and catecholamine release, leading to agitation and hindering recovery. Effective postoperative pain management is thus a critical focus for medical research and particularly for anesthesiologists.Regional anesthesia offers novel approaches to pediatric postoperative analgesia. Caudal epidural, a readily applicable and safe technique, has become widely adopted in pediatric anesthesia, facilitating day-care and select abdominal surgeries.

Newer, safer, highly efficacious local anesthetics have revolutionized postoperative pain management. These agents inhibit nerve impulse transmission by blocking voltage-gated sodium channels. While bupivacaine was widely used, its potential for cardiotoxicity and central nervous system toxicity prompted the increasing adoption of agents like ropivacaine, which offers a more favorable safety profile with reduced cardiotoxicity and motor blockade, while providing comparable analgesia [8,17].

This prospective, randomized study (2023-2024, SCB Medical College & Hospital, Cuttack) evaluated the efficacy and duration (time to first rescue analgesia) of caudal 0.25% bupivacaine versus ropivacaine (0.75mg/kg each) for postoperative pain management in 60 ASA I-II pediatric patients (3-6 years) undergoing elective infraumbilical surgeries (<1 hour) following ethics approval and informed consent. Caudal blocks were administered post-induction of general anesthesia with standard maintenance.

Study found that low-concentration, high-volume local anesthetic administration achieves differential blockade in children due to their smaller nerve fiber diameters and shorter internodal distances. Their findings indicate that a single-shot caudal block with 0.25% ropivacaine (1 mL/kg) provides comparable analgesia to an equivalent volume of 0.25% bupivacaine. Ropivacaine's reduced intrinsic toxicity and lower required mass enhance its safety margin, particularly relevant in pediatric anesthesia.

Demographic data (age, weight, sex) showed no significant intergroup differences ($p>0.05$), confirming comparable baseline characteristics. Similarly, surgical and anesthesia durations were statistically similar between groups ($p>0.05$).

Intra- and postoperative hemodynamic stability, assessed by monitoring mean arterial pressure (MAP) and pulse rate, showed no significant differences between the ropivacaine and bupivacaine groups at various intraoperative time points ($p > 0.05$; Table 5). This indicates comparable and well-maintained hemodynamic profiles, suggesting similar intra- and postoperative pain levels in both groups.

Statistical analysis ($p<0.0001$) revealed a significantly longer mean duration of motor blockade (Bromage scale) in the bupivacaine group (267.59±66.43 minutes) compared to the ropivacaine group (198.72±51.79 minutes), indicating a faster motor recovery with ropivacaine (Table 9).

Two studies by Da Conceicao *et al.* [14,18] demonstrated significantly less motor blockade with 0.25% ropivacaine compared to 0.25% bupivacaine via caudal administration at multiple postoperative time points ($p<0.05$).

Multiple studies indicate that ropivacaine is associated with less motor blockade compared to bupivacaine in pediatric caudal anesthesia [19]. Khalil S *et al.*[20] observed significant initial motor block with ropivacaine, which largely resolved within three hours, while bupivacaine exhibited a significantly slower motor recovery. Ivani G *et al.*[15] found that 0.2% ropivacaine ('p' = 0.02), but not

0.25% levobupivacaine ('p' = 0.18), resulted in significantly less motor block in the first postoperative hour compared to 0.25% racemic bupivacaine in 60 children aged 1-7 years undergoing minor subumbilical surgery. Negri *et al.*[21] concluded that low-dose (0.125%; 0.2 mg/kg) postoperative epidural infusions of levobupivacaine or ropivacaine were associated with significantly less unwanted motor blockade (p=0.03) than a similar bupivacaine infusion in children after hypospadias repair (n=26 in the bupivacaine group). Locatelli B *et al.*[22] demonstrated a significantly higher incidence of residual motor block with 0.25% bupivacaine compared to 0.25% levobupivacaine or ropivacaine ('p'<0.01) following caudal administration in children.

Sensory recovery, evaluated by cold cotton touch every 15 minutes for 3 hours then every 30 minutes for 5 hours postoperatively, showed a non-significant trend (p=0.061) towards longer block duration in Group R (83.58 ±20.78 min) compared to Group B (80.67 ±16.34 min). Time to first rescue analgesia (Hannallah pain score ≥4, treated with intravenous paracetamol 15 mg/kg) was significantly longer (p<0.01) in Group R (418.12±9.13 min) versus Group B (412.17±12.46 min), indicating superior postoperative analgesic duration for ropivacaine. Pain scores were assessed at 15-minute intervals for the initial 3 postoperative hours and then every 30 minutes for the subsequent 5 hours.

The finding of the present study aligns with prior research indicating that ropivacaine provides a longer duration of postoperative analgesia compared to bupivacaine [15,19,20]. Specifically, a study reported a significantly extended analgesic duration with ropivacaine (520 min) versus bupivacaine (253 min). However, in a separate pediatric caudal block study, the mean time to first analgesia was only slightly longer with ropivacaine (271.9 ± 120.9 min) compared to bupivacaine (233.2 ± 79.8 min). Similarly, Brescham C *et al.*[19], and other studies observed a statistically non-significant trend towards longer postoperative analgesia with ropivacaine (330 ± 56 min) compared to bupivacaine (282 ± 43.8 min) in pediatric caudal blocks for inguinal hernia repair.

Several studies comparing caudal bupivacaine and ropivacaine have yielded mixed results regarding analgesic duration. Ray *et al.*[30] reported a statistically non-significant trend towards longer analgesia with ropivacaine (405 ± 18 min) compared to bupivacaine (398 ± 23 min). Conversely, Da Conceicao *et al.*[14], Brescham *et al.*[19], Khalil *et al.*[20] and Locatelli *et al.*[22] found comparable sensory block and analgesic efficacy between the two local anesthetics via the caudal route.

This study demonstrates that caudally administered ropivacaine (0.25% at 0.75 mg/kg) exhibits comparable analgesic efficacy to bupivacaine (0.25% at 0.75 mg/kg) in pediatric infraumbilical surgeries. While postoperative analgesia duration showed inter-study variability, this investigation found ropivacaine provided a longer analgesic effect and a significantly shorter motor blockade compared to bupivacaine. Hemodynamic stability was equivalent between the groups, and the incidence of minor side effects (nausea/vomiting) was statistically insignificant for both ropivacaine (6.7%) and bupivacaine (13.3%). No major adverse events (respiratory depression, hypotension, urinary retention) were observed in either cohort.

The study's limited sample size constrained the detection of robust associations, necessitating further trials for definitive conclusions. While plasma concentrations of ropivacaine and bupivacaine were not quantified, clinical signs of local anesthetic toxicity were absent. The absence of ultrasound guidance for caudal block placement represents a methodological limitation impacting potential safety and efficacy.

Conclusion

A comparative clinical investigation of caudal 0.25% bupivacaine and 0.25% ropivacaine in pediatric patients for postoperative analgesia demonstrated that ropivacaine provided a significantly longer duration of analgesia and facilitated earlier motor blockade resolution compared to bupivacaine. These findings suggest that ropivacaine exhibits equipotent analgesic efficacy with a less pronounced motor blocking effect than bupivacaine, potentially enabling earlier postoperative ambulation due to its shorter motor blockade. Therefore, caudal ropivacaine presents a safe and effective alternative to bupivacaine for pediatric postoperative pain management, characterized by reduced motor blockade.

Declarations

Ethical Approval and Consent to participate

Yes (Istitutional Ethics Committee, SCB Medical College and Hospital, IEC Appln No: 1513/23.11.2023.

Availability of supporting data

Upon request to the corresponding author.

Competing interests

Nil

Funding Statement

Nil

Authors contributions

All authors made substantial contributions to the reported work, including in the areas of conception, study design, execution, data collection, analysis, and interpretation. They participated in drafting, revising, and critically reviewing the article, gave final approval for the version to be published, agreed on the journal for submission, and accepted responsibility for all aspects of the work.

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