

Comparison of Efficacy between 0.25% Bupivacaine and 0.25% Levobupivacaine for Caudal Anaesthesia in Paediatric Infraumbilical Surgeries

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Abstract

Regional anesthesia in paediatrics has been an evolving trend with the advent of newer drugs and techniques in terms of both safety and efficacy. The aim of this study was to compare effectiveness of local anaesthetic drugs – bupivacaine and levobupivacaine on duration of analgesia and post operative pain in paediatric population who underwent below umbilical surgeries.

Aim: Comparing the duration of analgesia between 0.25% levobupivacaine and 0.25% bupivacaine was the main goal. The comparison of hemodynamic parameters, the length of motor blockade, and the frequency of side effects between 0.25% bupivacaine and 0.25% levobupivacaine were the secondary goals.

Method: 70 patients were included in this randomized control study. The patients were allocated into two groups: the levobupivacaine (group A, n = 35) and the Bupivacaine group (group B, n = 35). All patients were given caudal block after minimal sedation before the surgery with either 0.25% levobupivacaine and 0.25% bupivacaine of 0.75ml/kg and duration of analgesia and motor residual blockade, intra operative and post operative hemodynamic parameters and the incidence of adverse events if any occurred were studied

Results: Levobupivacaine provided more duration of analgesia **131.37 ± 4.023 minutes** compared to bupivacaine **124.06 ± 2.807 minutes** in terms of both efficacy and quality. Levobupivacaine has lesser residual motor blockade when compared with bupivacaine at wakeup (**Modified Bromage >1**) with p value (**P = 0.037**) and 180mins using modified bromage scale. There was no difference in the hemodynamic parameters between the two groups signifying the drugs are hemodynamically stable. No adverse reactions were noted during our study empathizing the safety of the usage of drugs in the paediatric population.

Conclusions: Levobupivacaine comparatively had higher efficacy in terms of duration of analgesia and lesser motor blockade compared to bupivacaine for paediatric infra umbilical surgeries

Keywords: caudal, postoperative pain, residual motor blockade, paediatric, pain assessment.

INTRODUCTION

Pain is defined as ‘a distressing feeling often caused by an intense or damaging stimuli’.¹ Incompetent management for acute pain has both short- and long-term side effects. Numerous imaging studies have found long-lasting alterations in the structure and connections of the brain that are correlated with the degree of acute pain experienced during fetal life and with future changes in adult cognition and

behavior.^{2,3} Pain is a complex experience, resulting from the interaction between neural pathways and neurochemical mediators.

Various procedures and drugs have been tested up to this point to relieve post-operative pain in the paediatric population. The use of painkillers in children has been limited by their side effects. Research demonstrating analgesia's efficacy supports the safe and advantageous use of regional

anaesthesia in paediatric patients.^{4,5} Not only does it provide analgesia after surgery, but it also lessens the need for both inhaled and intravenous sedation.⁶ The most common regional anaesthetic method used in children for surgeries involving the abdomen and lower extremities is caudal epidural anaesthesia. Caudal block offers advantages over intravenous narcotics and other peripheral nerve blocks. There are various preparations of local anaesthetics available today.

Bupivacaine has consistently provided anaesthesia and analgesia with motor-sensory blocking ability for more than 40 years.⁷ A drug with a higher margin of safety and comparable therapeutic efficacy was required because of cardiotoxicity and instances of prolonged motor obstruction.⁸ As a result, the S-enantiomers of bupivacaine were discovered and developed. Levobupivacaine⁹, a pure S-enantiomer of bupivacaine, is said to offer a larger margin of safety due to its decreased cardiotoxicity and decreased postoperative motor blockage.

MATERIALS AND METHODS

This study was conducted at institution SMVMCH under the Department of Anaesthesiology on paediatric patients undergoing infraumbilical surgeries with caudal anaesthesia. This study was a double-blinded randomized prospective study design as per good clinical practice (GCP) guidelines by World Health Organization for a period of one and half years. The sample size was calculated from Sharma et al¹⁰ study considering 95% confidence interval and 80% power, the sample size for our study was determined to be 66. To round it off, we included 70 patients (35 each study group). An external person from community medicine department assisted in this process. Random allocation software was employed to generate the randomization sequence and handed over to the investigator in sealed, opaque, sequentially numbered envelopes. The first envelope was opened to determine the type of drug allocation. Participants were unaware of their group assignment. An anaesthesiologist not involved in the study administered the caudal block. An additional anaesthesiologist who was not involved made observations. The data recorder was unaware of the group assignment. The sequence was provided to the principal investigator in a sealed envelope, and decoding was performed by a statistician.

Inclusion criteria includes patients scheduled for elective below umbilical surgeries between 2 years to 8 years of male and female sex, weight ranging between 9 to 35 kg and expected duration of surgery less than 60 minutes. Exclusion criteria includes emergency procedure, history of known amide local anaesthetic medication hypersensitivity, ongoing renal, cardiac, neurological, or respiratory issues and not willing to participate in the study.

STUDY PROCEDURE:

The study was carried out at SMVMCH with the consent of the research committee and institutional ethics. Clinical Trials Registry India [CTRI] has the trial registered. **CTRI/2023/01/048753**

PROCEDURE:

A thorough history and pre-anaesthetic evaluation were completed the day before the procedure. The patient's parents gave their written, informed consent before the planned procedures. The patients were moved into the operating room and vitals measured. Pre-induction drugs were administered as glycopyrrolate (0.004 mg/kg), midazolam (0.02 mg/kg), and ondansetron (0.05 mg/kg). Fentanyl (2 mcg/kg) and Propofol (2 mg/kg) were used to induce and depth of anaesthesia maintained with 1-2% sevoflurane and 50% N₂O with 50% oxygen. The study drug was deposited after confirming negative aspiration for blood and CSF in left lateral decubitus position by loss of resistance technique.

Group A- Levobupivacaine 0.25% (0.75 ml/kg)

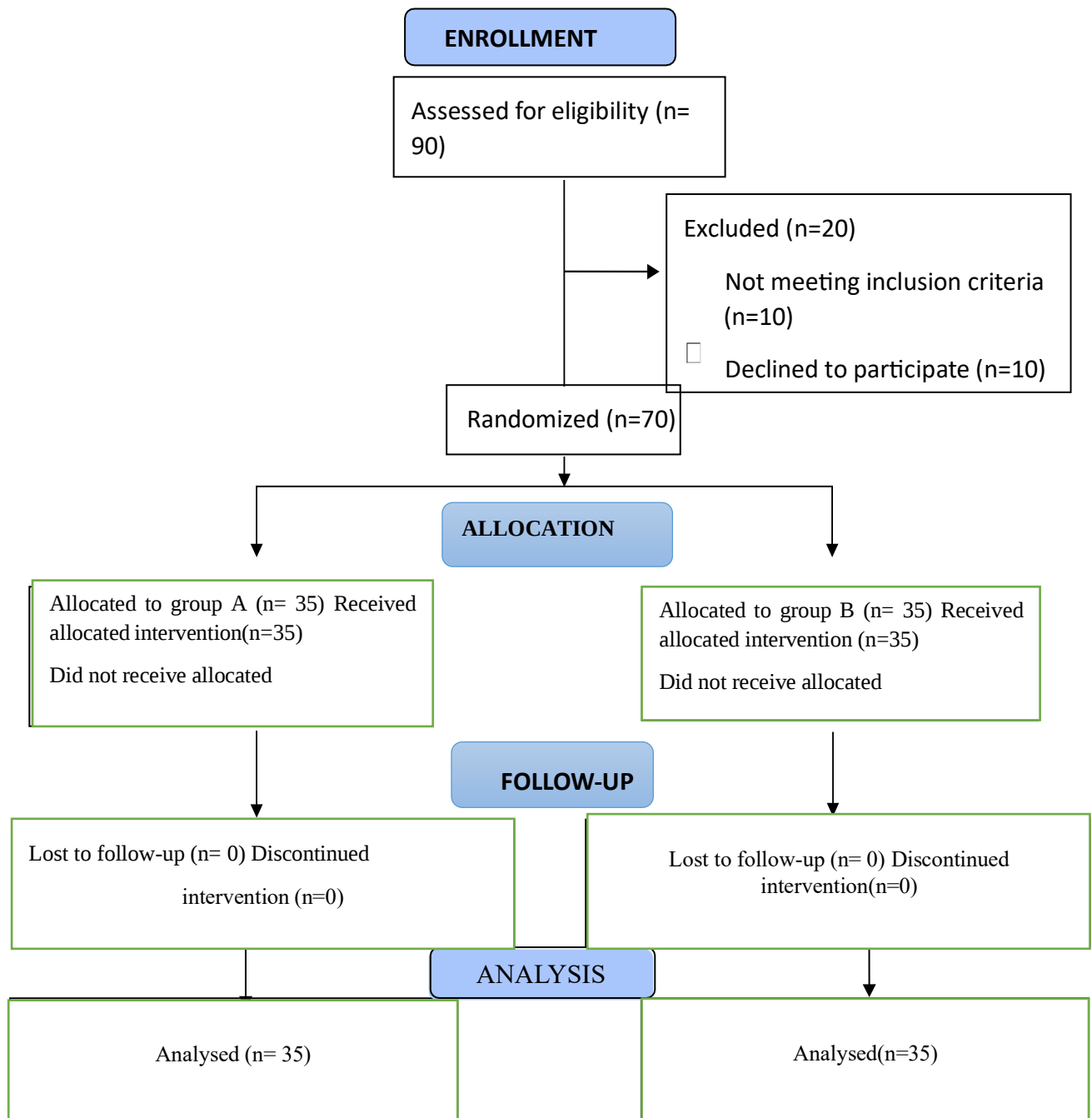
Group B – Bupivacaine 0.25% (0.75 ml/kg)

The baseline parameters were those recorded just prior to the caudal block. When forceps were applied at the surgical site after 10 minutes and any two of the following conditions were met, caudal block was considered ineffective if substantial movements, a rise in pulse rate of more than 20% and rise in respiratory rate of more than 20%. Vital signs such as heart rate (HR), systolic blood pressure (SBP), and oxygen saturation (SpO₂) were monitored. The readings were documented every three minutes for the first fifteen minutes, five minutes for the next thirty, and thirty minutes for the last 120 minutes. Next to surgery, motor blockage was evaluated upon wake-up, then every 15 minutes for an hour, and finally every 30 minutes for the next hour. The patient can move their hip, knee, and ankle with a score of 0 on the Modified Bromage Scale, whereas a patient with a score of 1 cannot move their hip, but

they can move their knee and ankle, a patient with a score of 2 cannot move their hip and knee, but they can move their ankle, and a patient with a score of 3 cannot move their hip, knee, and ankle. A motor block score of greater than one upon waking up and 180 minutes following caudal block was considered significant residual motor block. Following surgery, the PACU evaluated hemodynamics, breathing, motor blockade, and pain every 15 minutes for the

first hour and every half hour for the following hour. The FLACC scale was used to measure pain. A score of >4 indicated severe pain that required rescue analgesia. An intravenous dose of 15 mg/kg paracetamol was used as a rescue analgesic. The adverse effects of amide local anaesthetics such as vomiting, bradycardia, hypotension, allergic reactions were observed in the post operative period and documented whenever manifested.

CONSORT CHART



Statistical analysis

SPSS 22 version software was used for data analysis after the data was entered into a Microsoft Excel data sheet. Frequencies and proportions were used to depict categorical data. For qualitative data, the chi-square test was employed as a significance test. The mean and SD were used to represent continuous data. **Normality of the continuous data**, was tested by **Kolmogorov-Smirnov test and the Shapiro-**

Wilk test. Independent t test was used as test of significance to identify the mean difference between two quantitative variables. **Mann Whitney U test** was used for Non-parametric data between two groups. **Graphical representation of data:** MS Excel and MS word was used to obtain various types of graphs such as Line diagram, bar diagram. **p value** (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Table 1-Comparison Of Mean Age,Gender,Weight,Asa Grading And Duration Of Surgery Between Levobupivacaine And Bupivacaine

SL.NO	PARAMETERS	LEVOBUPICAINE GROUP A	BUPIVACAINE GROUP B	P VALUE
1	MEAN AGE (years)	4.74	4.37	0.502
2	GENDER			0.314
	MALE	97.10%	100%	
	FEMALE	2.90%	0%	
3	ASA GRADING	100%	100%	-
4	MEAN WEIGHT(KG)	14.8	14.06	0.558
5	DURATION OF SURGERY(MINS)	23.14	20.29	0.231

There were no significant difference between mean age,gender,weight,ASA grading and duration of surgery between two groups and were statistically not significant

There were no statistical difference between heart rate, systolic BP and respiratory rate between the two groups at different intervals of time

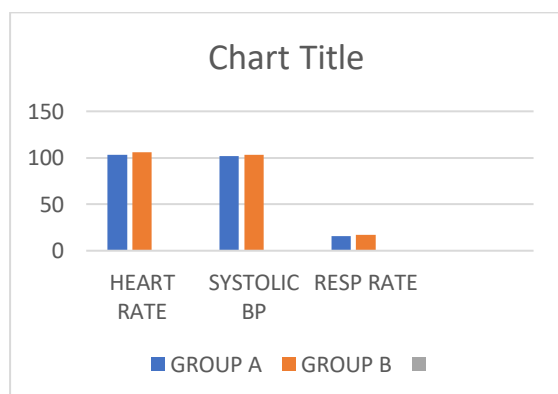


FIGURE 1 – Bar diagram showing comparison of heart rate ,systolic blood pressure and respiratory rate between two groups

Table 2: Mean Duration of Analgesia comparison

	Group	N	Mean	SD	P value
Duration of Analgesia [mins]	Levobupivacaine	35	131.37	4.023	<0.001*
	Bupivacaine	35	124.06	2.807	

Independent Samples Test

Mean Duration of Analgesia in Levobupivacaine was 131.37 ± 4.023 min and Bupivacaine was 124.06 ± 2.807 mins- **STATISTICALLY SIGNIFICANT**

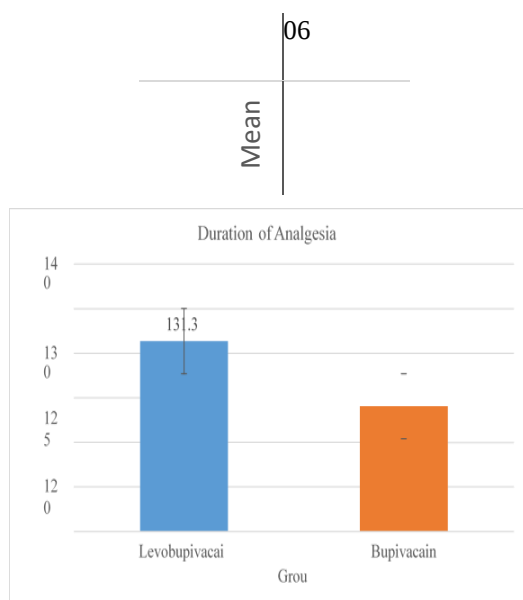


Figure 2: Bar diagram showing Mean Duration of Analgesia in Levobupivacaine and Bupivacaine groups. The difference is statistically significant.

of Analgesia comparison

Table 3: Modified Bromage Scale comparison at different intervals of follow-up

Modified Bromage Scale	Group						P value
	Levobupivacaine			Bupivacaine			
	Mean	SD	Median	Mean	SD	Median	
At Wake Up	2.49	0.56	2	2.74	0.44	3	0.037*
At 180mins	0.29	0.46	0	0.54	0.51	1	0.029*

Mann-Whitney U Test

Median Modified Bromage Score was low in Levobupivacaine compared to Bupivacaine between two groups at Wake up and at 180 mins-

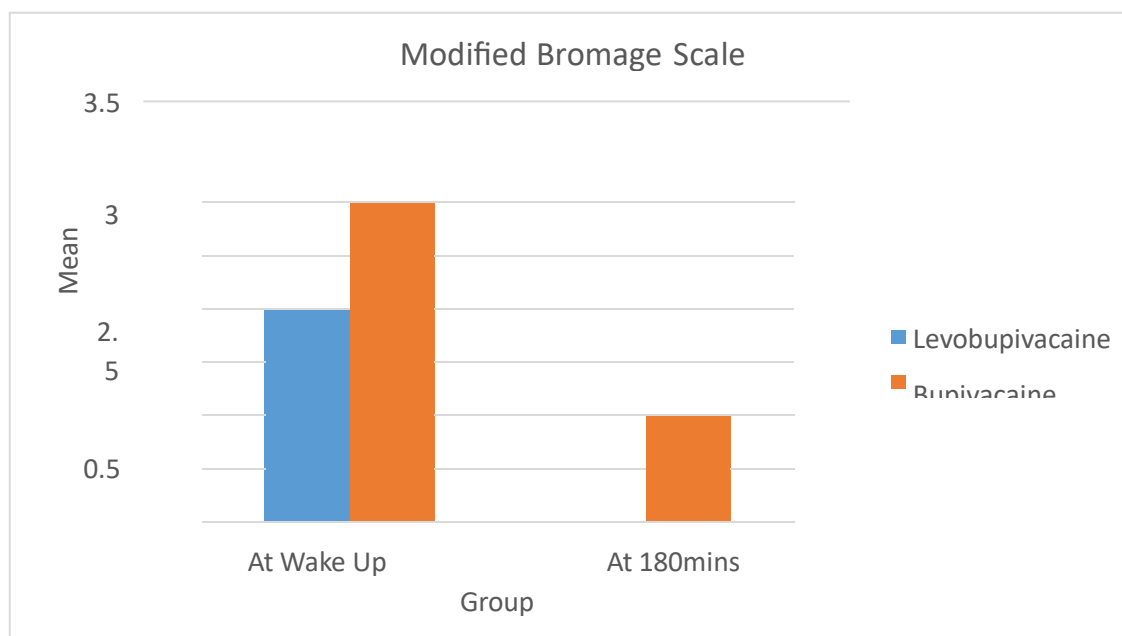


Figure 3: Bar diagram showing Modified Bromage Scale comparison at different intervals of follow-up for Levobupivacaine and Bupivacaine groups.

DISCUSSION:

Day care surgery is the area of the health care system that is always growing. This necessitates the use of an anaesthetic technique with minimal side effects, maximum comfort, and low stress reaction. The most crucial aspect paediatric anaesthesia is pain management.^{2,3} Opioids have downsides such as higher risk of nausea and sedation in addition to their low cost. Abdominal and lower limb orthopaedic procedures can be performed with central neuraxial blocks such as spinal, single shot caudal epidural, continuous epidural infusion, and paravertebral blocks. Caudal block is easy to perform and found to be effective than ilio inguinal and ilio hypogastric nerve block and most commonly performed one.¹¹

Demographic variables like age, gender and ASA physical status were summarized. In Levobupivacaine group the majority of the subjects were in age group of 2 years (31.4%) and in bupivacaine group it is 34.3%, where there was no statistical difference in age distribution between two groups. Comparing the sex of both the groups 97.1% were males and 2.9% were females in levobupivacaine group and in Bupivacaine, 100% were males. There was no significant difference in gender distribution between the two groups. We observed that the duration of analgesia in group A was 131.37 ± 4.023 minutes and in group B was 124.06 ± 2.807 minutes. and the difference was statistically significant with p value less than 0.001 which shows Levobupivacaine having increased effectiveness compared to that of bupivacaine and found to be equally effective and superior at similar concentrations for infraumbilical surgeries in paediatric populations. According to Breachan et al.¹² the postoperative analgesia lasted 5.75 hours for the Levobupivacaine group and 5.35 hours for the Bupivacaine group in children aged 1 to 7 years. The difference was statistically not significant. The above study finding is also supported by study done by Ivani et al.¹³ in children aged 1 to 7 years who found out that Bupivacaine, Levobupivacaine and Ropivacaine are clinically comparable in caudal block. Although various studies have been demonstrating the equal effectiveness of bupivacaine and levobupivacaine with several other local anaesthetics, levobupivacaine has been implemented in present practice owing to the

incidence of less adverse reactions. Post-operative pain assessment was measured using the FLACC scoring system. This was done to evaluate the effectiveness and duration of analgesia. We selected the FLACC²⁰ scoring system out of all the ones mentioned because it is simple to use, can be applied to both awake and asleep children, grades pain into mild, moderate, and severe categories, can be applied to nonverbal children, and has an observational score that is the only one that does not cause the child undue distress during the recovery period. Group A's FLACC scores were lower in the immediate post operative period, they were not statistically significant. All patients in group B had FLACC >4 at the conclusion of 120 minutes, and at the conclusion of 150 minutes, all patients in both groups had FLACC >4. Levobupivacaine in comparison with Bupivacaine was shown to provide equivalent analgesia post-operatively in terms of both length and quality since the difference was statistically not significant. This was further corroborated by research conducted by Jadhav et al.¹⁴ on sixty children undergoing inguinal herniotomies, which discovered that the FLACC scores of the two groups were similar. Thus, it proves that the effectiveness of bupivacaine and levobupivacaine is equal. Levobupivacaine appears to have a little benefit over bupivacaine in the early post-operative period, as seen by a lower FLACC score. The determination of residual motor blockade was another main objective. When compared to the Group A, patients in group B showed residual motor blockage (Modified Bromage >1) at wake-up ($P = 0.037$) which was statistically significant. At 180 minutes following caudal epidural block, Median Modified Bromage Score was low in Levobupivacaine compared to Bupivacaine. Residual motor blockade eventually declined. In 182 paediatric patients undergoing orchidopexy and herniotomy procedures, Breachan et al.¹² investigated the efficacy of analgesics and motor blockade using 1 milliliter per kilogram of 0.2% levobupivacaine, ropivacaine, and bupivacaine. Levobupivacaine and bupivacaine produced 25% and 60% motor blockage, respectively, within the first hour following surgery, according to their statistically significant results. After two hours, they were unable to identify any notable differences between the three groups. They proposed that

levobupivacaine would be the better option for day care procedures because of its weak motor block. This finding was also supported by **Negri et al**¹³ who studied in children who underwent hypospadias repair. When an epidural infusion of 0.125% bupivacaine was utilized, the incidence of unwanted motor obstruction was 21.4%, while levobupivacaine produced zero cases.

Both groups had basic hemodynamic parameters, such as heart rate and systolic blood pressure and respiratory rate were similar. Following caudal block, the mean heart rates in both groups decreased. The statistical analysis revealed that group B saw a greater decrease in heart rate than group A. Since the lowered heart rate was not more than 20% below the baseline, none of the kids needed therapy to lower their heart rates. In both groups, there was a little increase in mean heart rate 120–150 minutes post-operatively, or 3–4 hours after caudal block. This could be because caudal impact was wearing off and patients were beginning to feel pain. The study was done using landmark guided caudal technique. We did not use an ultrasound machine for the advantages and pitfalls in drug administration. Moreover the caudal technique was done in lateral approach for ease of insertion with a small sample size. With the advent of ultrasound machine, the identification of caudal space has become easier and the administration of the drug can be confirmed.

CONCLUSION

The present study compared the effect of 0.25% bupivacaine and 0.25% levobupivacaine for caudal anaesthesia in paediatric population undergoing infraumbilical surgeries and derived on the following conclusions. Levobupivacaine provided more duration of analgesia compared to bupivacaine in terms of both efficacy and quality. Levobupivacaine has lesser residual motor blockade when compared with bupivacaine at wakeup and 180 mins using modified Bromage scale. There was no difference in the hemodynamic parameters between the two groups signifying the drugs are hemodynamically stable. No adverse reactions were noted during our study emphasizing the safety of the usage of drugs in the paediatric population.

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