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To compare the efficacy of hyperbaric levobupivacaine (0.5%) versus hyperbaric bupivacaine (0.5%) in the subarachnoid block for infraumbilical surgeries

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ABSTRACT

Background: Spinal anesthesia is the neuraxial regional anesthesia technique used in infraumbilical surgeries such as inguinal hernia, hydrocele, hysterectomy, and lower limb surgeries. Levobupivacaine and bupivacaine are local anesthetic agents used for spinal anesthesia. **Aims and Objectives:** The aim of the study was to compare the efficacy of hyperbaric levobupivacaine (0.5%) versus hyperbaric bupivacaine (0.5%) in subarachnoid blocks for infraumbilical surgeries. **Materials and Methods:** A total of 112 patients with American Society of Anesthesiologists grades 1 and 2 scheduled for infraumbilical surgeries were randomly divided into two groups. Group L received 3 mL of hyperbaric levobupivacaine, and group B received 3 mL of hyperbaric bupivacaine intrathecally. The onset of sensory block, onset, and duration of motor block, duration of analgesia and time of first rescue analgesia, hemodynamic parameters, and post-operative side effects, if any, were recorded. **Results:** The time of onset of sensory block at T10 for group L was 03.16 ± 00.29 min and for group B was 02.16 ± 00.27 min and the time of onset of motor block was higher in group L (03.29 ± 00.32 min) compared to group B (02.45 ± 00.32 min). Duration of motor block was significantly shorter in group L (209.80 ± 6.44 min) compared to group B (252.41 ± 11.49 min). All these findings were statistically significant. **Conclusion:** Levobupivacaine had a delayed onset of sensory and motor block as compared to bupivacaine, but due to its short duration of motor block and better hemodynamic profile, it seems to be a better alternative to bupivacaine.

Key words: Levobupivacaine; Bupivacaine; Subarachnoid block

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INTRODUCTION

Spinal anesthesia is the most common regional anesthesia technique used in infraumbilical surgeries such as inguinal hernia, hydrocele, incisional hernia, hysterectomy, and lower limb surgeries. It has quicker action, better sensory and motor block, predictable duration of action, fewer side effects, and reliable offsetting.[1] It produces an intense nerve block in a large part of the body by injecting a small amount of a local anesthetic agent into the subarachnoid pace.[2] Spinal anesthesia was the first regional anesthesia that was carried out, and the first surgery under spinal anesthesia was made in 1898 in Germany by August Bier.[3] Bupivacaine is a racemic mixture made of dextro and levo isomers. Levobupivacaine is an amide local anesthetic that can serve as a substitute for bupivacaine. This is the S(-) enantiomer of racemic bupivacaine. Levobupivacaine has lower cardiac and central nervous system toxicity when compared to both R (+) bupivacaine and bupivacaine.[4] Levobupivacaine has a lower affinity for cardiac sodium channels and greater plasma protein binding affinity compared to the dextro isomer, thus reducing the risk of cardiotoxicity.[5]

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Aims and objectives

The aim of the study was to compare the efficacy of hyperbaric levobupivacaine (0.5%) versus hyperbaric bupivacaine (0.5%) in subarachnoid block for infraumbilical surgeries. To compare the hemodynamic stability of the two drugs.

MATERIALS AND METHODS

Following approval from the Institutional Ethics Committee certificate no. "113/IEC-GRMC/2022," this prospective randomized double-blind study was conducted at G.R. Medical College and JAH group of hospitals from 2022 to 2024 with CTRI registration no. CTRI/2023/06/054293.

Inclusion criteria

Patient giving consent to participate in the study and scheduled for elective infraumbilical surgeries such as inguinal hernia, lower limb surgeries, TAH, and VH.

- Aged between 20 and 70 years
- ASA grade I and II.

Exclusion criteria

- Patients not given consent to participate in the study
- Patients with respiratory, cardiovascular, hepatic, renal diseases, obesity, and pregnancy
- Any bleeding disorder and patient on anticoagulants
- Neurological and musculoskeletal disease
- Local infection at the injection site
- Patient with known hypersensitivity to local anesthetic.

Sample size calculation

The sample size was calculated from a study done by Thakore et al.[6]

The average duration of analgesia for group levobupivacaine is mean±SD=222.6±26.2.

The average duration of analgesia for group bupivacaine is mean±SD=206.1±35.3.

Using the formula for sample size:

$$n = \frac{2S^2\left(Z_{\alpha} + Z_{1-\beta}\right)^2}{\left(\mu_1 - \mu_2\right)^2} = \frac{2 \times 966.265 \times \left(1.96 + 0.84\right)^2}{\left(16.5\right)^2}$$

n=56

So, for each group, 56–56 samples were taken.

Group of selected individual	
Group B (n=56)	Received 3 mL of hyperbaric bupivacaine (0.5%)
Group L (n=56)	Received 3 mL of hyperbaric levobupivacaine (0.5%)

Grouping: Selected 112 patients of ASA grade I and II scheduled for infraumbilical surgeries under spinal anesthesia were randomly divided into two groups (n=56 each) by envelope method as below:

Before anesthesia, as per institutional protocol, a pre-anesthetic assessment was conducted to screen for and evaluate any significant systemic illnesses. Informed consent was obtained from all patients participating in the study, and they were briefed about the spinal anesthesia procedure and educated on the use of the Visual Analog Scale (VAS). The day before surgery, all patients underwent a comprehensive general, physical, and systemic examination. In addition, all necessary routine investigations were performed.

All patients were instructed to abstain from oral intake for a minimum of 8 h before the procedure. Upon the patient's arrival in the operating theater, an 18 G cannula was inserted into the patient's forearm for intravenous access and pre-loading was carried out with approximately 10 mL/kg of Ringer's lactate solution or with normal saline. Standard monitors, including a pulse oximeter, blood pressure cuff, and electrocardiogram, were applied, and observations were documented using a multipara monitor.

Following meticulous aseptic measures, a lumbar puncture was performed in the sitting/lateral position at the L3-L4 interspace through a midline approach using a 23G Quincke spinal needle. Subsequently, spinal anesthesia was administered, the study drug was injected, and the patient was positioned supine for the duration of the study. Intraoperatively, various characteristics and outcomes of the spinal anesthesia were recorded and documented in a *pro forma* for subsequent statistical analysis.

1. Sensory blockade onset time (up to T10) was evaluated using the pinprick method
2. Motor blockade onset time was assessed according to the Bromage scale as discussed by Gulec et al.[7]
3. Duration of motor blockade (modified Bromage scale 0)
4. Duration of analgesia is defined as from induction of spinal anesthesia to onset of pain
5. VAS score: Post-operative pain was assessed by a visual analogic score scale consisting of a 10 cm horizontal scale with gradations marked as "0" means no pain at all and 10 means worst pain imaginable. VAS score was noted at 1, 2, 3, 4, 5, 6, 7, and 8 h after spinal anesthesia. VAS score >3 was managed with rescue analgesia with an injection of tramadol 2 mg/kg i.v. in 100 mL of normal saline to relieve post-operative pain
6. Time of first rescue analgesia TRA1 is defined as the time interval from induction of spinal anesthesia to the patient requiring the first dose of rescue analgesia

7. Hemodynamic parameters (pulse rate [PR], systolic blood pressure [SBP], diastolic blood pressure [DBP], and mean arterial pressure [MAP]) were assessed at 0, 30, 60, 90, and 120 min intraoperatively and for the same period postoperatively. Any decrease in MAP below 20% of baseline prompted a bolus dose of mephenteramine 6 mg i.v., whereas PR below 60 beats/min was addressed with atropine sulfate 0.3–0.6 mg i.v.

RESULTS

As shown in Table 1, age, sex, and weight were comparable between the groups, P>0.05 which was statistically insignificant.

As shown in Table 2, the onset of sensory and motor blockade was faster in group B as compared to group L, P<0.001 which was statistically highly significant. Furthermore, the duration of analgesia and the duration of motor blockade was shorter in group L when compared to group B with P<0.001 (highly significant).

As shown in Figure 1, before induction of anesthesia, group L and group B had comparable heart rates as P>0.05 and were statistically insignificant.

After induction of spinal anesthesia, there was an increase in heart rate in group B from baseline whereas group L showed a stable pattern. As P<0.05, the difference was statistically significant.

From Figure 2, it was interpreted that baseline MAP was comparable between both the groups, while after induction of anesthesia, there was a decrease in MAP in both the groups but group B had significantly lower MAP when compared to group L with P<0.05.

Table 1: Demographic profile (mean±standard deviation) associated with the groups

Demographic parameter	Group L (n=56)	Group B (n=56)	P-value
Age	46.18±11.11	47.36±11.18	0.577
Sex (%)			0.089
Male	41.1	57.1	
Female	58.9	42.9	
Weight (kg)	61.00±9.83	62.09±9.03	0.543

Figure 3 showed the post-operative VAS scores and compared between group L (hyperbaric levobupivacaine) and group B (hyperbaric bupivacaine) at various time intervals up to 8 h post-surgery. Rescue analgesia was given when the VAS score was >3. Comparing post-operative VAS scores between the two groups revealed that both groups experienced similar pain levels in the 1st and 2nd post-operative hours. VAS score was significantly higher in group L as compared to group B which showed that the need for rescue analgesia was earlier in group L as compared to group B. Rescue analgesia in group L was given in the 5th h on the other hand in group B due to better pain control, the need of rescue analgesia was delayed.

Table 3 showed that the time for first rescue analgesia was longer in group B as compared to group L with P<0.001, which was highly significant.

Incidence of tachycardia, hypotension, and shivering were higher in group B as compared to group L but the difference was insignificant.

DISCUSSION

Spinal anesthesia is a variety of neuraxial anesthesia in which the local anesthetic agent is directly injected into the subarachnoid space. It has been used in many surgical procedures due to its benefit for awake patients, rapid onset of action, ease of placement, low cost of drugs, low stress response, lesser side effects, and lower hospital stay. The most commonly used local anesthetic is bupivacaine which is associated with cardiotoxicity, but its S(-)enantiomer, levobupivacaine, has fewer effects on the cardiovascular and central nervous system due to its faster protein binding rate.

An assessment of the effects of the study drugs under spinal anesthesia in terms of onset and duration of sensory and motor blockade and duration of analgesia was done. Side effects were also noted.

In our study, the demographic characteristics such as age, gender, and weight were comparable between both groups. Duggal et al.,[8] and Sharma and Gupta[9] did not find any significant difference between the groups in terms of demographic data.

Table 2: Parameters of spinal anaesthesia

Parameters	Group L (n=56)	Group B (n=56)	P-value
Onset of sensory block (min)	03.16±0.29	02.16±0.27	<0.001
Onset of motor block (min)	03:29±00:32	02:45±00:32	<0.001
Duration of motor block (min)	209.80±6.44	252.41±11.49	<0.001
Duration of analgesia (min)	238.05±7.69	268.71±11.44	<0.001

P>0.05 insignificant, P<0.05 significant, P<0.001 highly significant

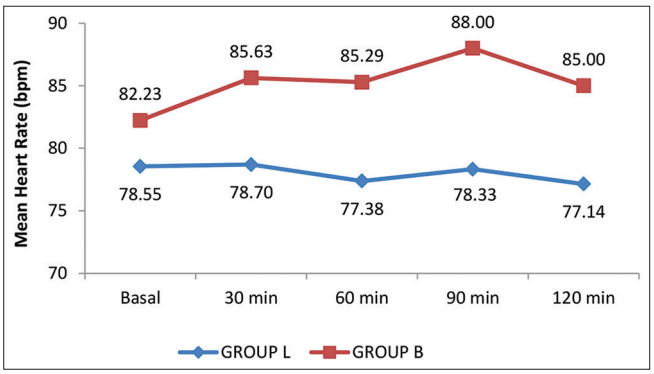

Figure 1: Comparison of intraoperative mean heart rate between study groups

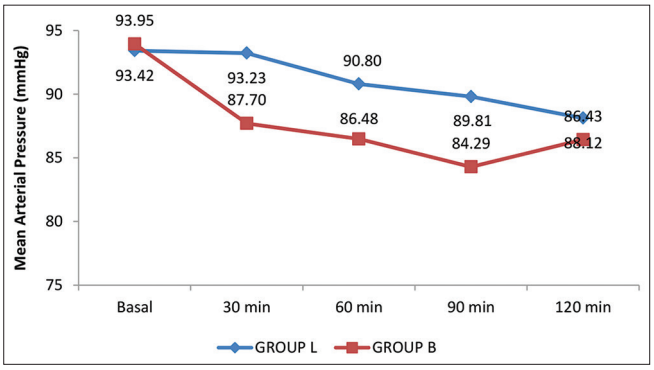

Figure 2: Comparison of intraoperative mean arterial pressure between study groups

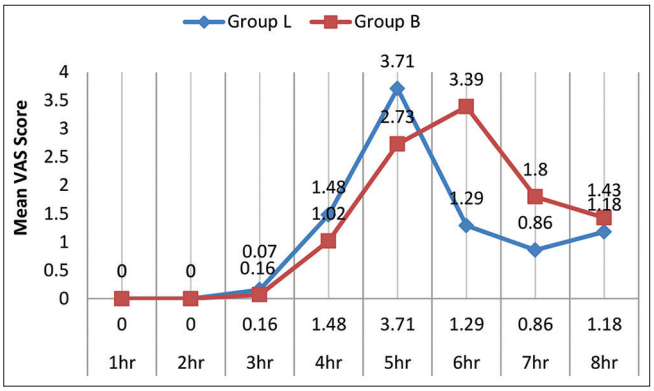

Figure 3: Comparison of postoperative visual analogue scale score

The time of onset of sensory block at T10 was earlier in group B when compared with group L with a P<0.001, which was highly significant. A study done by Thakore et al.,[6] showed a similar result. Other studies done by Sundarathiti et al.,[10] and Das et al.,[11] also showed similar results.

In our study, the duration of analgesia was longer in group B when compared with group L, P<0.001, and the differences were statistically significant. Girish et al.,[12] and

Table 3: Time for first rescue analgesia

Parameter	Group L (mean±SD)	Group B (mean±SD)	P-value
TRA1 (h)	4.709±0.26	5.580±0.32	<0.001

SD: Standard deviation

Table 4: Side effects and complications

Side effects	Group L		Group B		P-value
	n	%	n	%	
Tachycardia	2	3.6	5	8.9	0.242
Bradycardia	0	0	0	0	0
Hypotension	4	7.1	10	17.9	0.086
Hypertension	0	0	0	0	0
Shivering	1	1.8	3	5.4	0.309

Pearson Chi-square test was applied. P<0.05 is considered as significant

Duggal et al.,[8] also found similar results in their research.

The onset of motor block was earlier in group B (02.45±00.32 min) compared to group L (03.29±00.32 min), and the difference was highly significant. Girish et al.,[12] and Manisha et al.,[13] in their research found similar results.

The duration of the motor block was significantly shorter in group L compared to group B, P<0.001. This described the benefit of using levobupivacaine as early ambulation after spinal anesthesia was possible. Das et al.,[11] in their study found similar results.

Hemodynamic parameters including PR, SBP, DBP, and MAP were recorded at pre-induction and S30, S60, S90, S120, and S240 min after induction intraoperatively.

There was a sudden increase in heart rate after induction in group B as compared to group L. When a comparison of mean arterial blood pressure was done, the bupivacaine group showed a greater decrease in MAP after induction than the levobupivacaine group which shows the cardiac stability of levobupivacaine.

Malik et al.,[14] and Goyal et al.,[4] also found similar results as in our study.

In our study, the VAS score was assessed at 1, 2, 3, 4, 5, 6, 7, and 8 after induction. The VAS score >3 was at the 5th h in group L and at the 6th h in group B. When the VAS score was >3, we gave rescue analgesia with an injection of tramadol 2 mg/kg intravenous in 100 mL of normal saline to relieve post-operative pain. Similar results were seen in the research conducted by Subasi et al.,[15] and Hakan Erbay et al.[16]

The time for the first rescue analgesia was significantly longer in the bupivacaine group compared to the levobupivacaine group, with a P<0.001. This suggested that the duration of analgesia was greater in the bupivacaine group. Manisha et al.,[13] and Duggal et al.,[8] found similar results as in our study.

In our study, the incidence of side effects was more in group bupivacaine as compared to levobupivacaine in the post-operative period. Hence, levobupivacaine provided better hemodynamic stability and lesser side effects as compared to bupivacaine. However, the difference was insignificant.

Similar finding were seen the study conducted by Erbay et al.,[16] in which incidence side effects were more common in group bupivacaine when compared to group levobupivacaine Table 4.

Limitations of the study

The major limitation of our study was that the investigator was unable to objectively quantify and evaluate postoperative pain which being a subjective experience can be a major limiting factor in comparing and estimating the effectiveness of various modalities of treatment.

CONCLUSION

We concluded from our study that administration of hyperbaric levobupivacaine in spinal anesthesia as an alternative to bupivacaine in patients undergoing infraumbilical surgeries decreases the duration of motor block and duration of analgesia along with increase in sensory and motor onset time when compared with bupivacaine. Hemodynamic parameters during intra operative period were more stable in levobupivacaine when compared to bupivacaine. Along with this, incidence of post operative side effects was also less in group levobupivacaine. Thus, use of levobupivacaine facilitate early ambulation of the patient after spinal anesthesia along with better hemodynamic profile and lesser side effect as compared to bupivacaine.

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REFERENCES

1. Kalaria R and Upadhyay MR. Spinal anaesthesia for lower abdominal surgery: Levobupivacaine versus racemic bupivacaine. J Clin Diagn Res. 2018;12(3):UC09-UC13.
https://doi.org/10.7860/jcdr/2018/31422.11327
2. Hocking G and Wildsmith JA. Intrathecal drug spread. Br J Anaesth. 2004;93(4):568-578.
https://doi.org/10.1093/bja/aeh204
3. Olawin AM and Das JM. Spinal anesthesia. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2024.
4. Goyal A, Singi Y, Mallya P, Bhat G and Shankaranarayana P. A comparison between intrathecal levobupivacaine and bupivacaine for quality and safety during infraumbilical surgeries. Cureus.2022;14(10):e30590.
https://doi.org/10.7759/cureus.30590
5. Singh A, Gupta A, Datta PK and Pandey M. Intrathecal levobupivacaine versus bupivacaine for inguinal hernia surgery: A randomized controlled trial. Korean J Anesthesiol. 2018;71(3):220-225.
https://doi.org/10.4097/kja.d.18.27191
6. Thakore S, Thakore N, Chatterji R, Chatterjee C and Nanda S. Evaluating the efficacy of low-dose hyperbaric levobupivacaine (0.5%) versus hyperbaric bupivacaine (0.5%) along with fentanyl for subarachnoid block in patients undergoing medical termination of pregnancy and sterilization: A prospective, randomized study. J Obstet Anaesth Crit Care. 2018;8(2):90.
https://doi.org/10.4103/joacc.joacc_51_17
7. Gulec D, Karsli B, Ertugrul F, Bigat Z and Kayacan N. Intrathecal bupivacaine or levobupivacaine: Which should be used for elderly patients? J Int Med Res. 2014;42(2):376-385.
https://doi.org/10.1177/0300060513496737
8. Duggal R, Kapoor R and Moyal G. A comparison of intrathecal levobupivacaine with hyperbaric bupivacaine for elective cesarean section: A prospective randomized double-blind study. J Obstet Anaesth Crit Care. 2015;5(2):78.
https://doi.org/10.4103/2249-4472.165135
9. Sharma K and Gupta A. To study the hemodynamic stability between 0.5% hyperbaric bupivacaine and 0.5% hyperbaric bupivacaine for spinal anesthesia in caesarean section. Int J Sci Res. 2019;8(10):1-2.
https://doi.org/10.36106/ijsr
10. Sundarathiti P, Sangdee N, Sangasilpa I, Prayoonhong W and Papoun S. Comparison of intrathecal bupivacaine, levobupivacaine for cesarean section. J Med Assoc Thai. 2014;97(7):710-716.
11. Das SK, Rajsamant NK, Thatei C and Jena S. A comparative analysis of hyperbaric bupivacaine and levobupivacaine for spinal anaesthesia in caesarean sections. Stud J Health Res Afr. 2023;4(12):7.
https://doi.org/10.51168/sjhrafrica.v4i12.916
12. Girish BK, Srinivas HT and Shwetha M. A comparative study of hyperbaric 0.5% levobupivacaine with bupivacaine 0.5% for spinal anaesthesia in elective surgeries. Indian J Anesth Analg. 2018;5(12):2013-20.
https://doi.org/10.21088/ijaa.2349.8471.51218.8
13. Kapdi M, Shah V, Soni E and Bhagwani D. Comparison of hyperbaric levobupivacaine/bupivacaine for ceserean section. Int J Adv Res. 2023;11:794-799.
14. Malik I, Kamboj S and Kamal H. Comparison of intrathecal

bupivacaine with levobupivacaine using fentanyl as an adjuvant for transurethral resection of prostate-A randomised controlled trial. J Clin Diagn Res. 2023;17(2):UC16-UC20.

https://doi.org/10.7860/JCDR/2023/60359.17468

15. Subasi D, Ekinci O, Kuplay Y, Muftuoglu T and Terzioglu B. Comparison of intrathecal hyperbaric bupivacaine and levobupivacaine with fentanyl for caesarean section. Med J Goztepe Train Res Hosp. 2012;27(1):22-29.

https://doi.org/10.5222/J.GOZTEPETRH.2012.022

16. Hakan Erbay R, Ermumcu O, Hanci V and Atalay H. A comparison of spinal anesthesia with low-dose hyperbaric levobupivacaine and hyperbaric bupivacaine for transurethral surgery: A randomized controlled trial. Minerva Anestesiol. 2010;76(12):992-1001.

Authors' Contributions:
RG- Definition of intellectual content, literature survey, prepared the first draft of the manuscript, implementation of the study protocol, data collection, data analysis, manuscript preparation, and submission of the article; **JA**- Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **PG**- Design of study, statistical analysis, interpretation, and review manuscript; **SP**- Literature survey and preparation of figures; **BT**-coordination and manuscript revision.

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