Section: Anaesthesiology

Original Research Article

A PROSPECTIVE COMPARATIVE STUDY OF INTRATHECAL HYPERBARIC LEVOBUPIVACAINE (0.5%) WITH INTRATHECAL HYPERBARIC ROPIVACAINE (0.75%) FOR LOWER SEGMENT CAESAREAN SECTION

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ABSTRACT

Background: To compare intrathecal hyperbaric levobupivacaine 0.5% and intrathecal hyperbaric ropivacaine 0.75% in parturients undergoing elective lower segment caesarean section, with respect to haemodynamic parameters, sensory and motor block characteristics, postoperative analgesia, and adverse effects. **Materials and Methods:** This prospective, randomized, double-blind clinical investigation has been carried out at BGS Global Institute of Medical Sciences in Bengaluru, Karnataka, India, after approval from Institutional Ethics Committee (IEC). There have been 120 American Society of Anesthesiologists (ASA) physical status II parturients between ages of 18 and 40 who had elective lower segment caesarean section (LSCS). Group L received 2.2 mL of 0.5% hyperbaric levobupivacaine, equivalent to 11 mg, Group R received 2.2 mL of 0.75% hyperbaric ropivacaine, equivalent to 16.5 mg, intrathecally. Haemodynamic variables, sensory and motor block characteristics, Numerical Rating Scale scores, rescue analgesic requirement, adverse effects were recorded. Data were analysed using appropriate parametric and non-parametric statistical tests, with $p<0.05$ considered statistically significant. **Results:** While systolic and diastolic blood pressure, heart rate, oxygen saturation were comparable, mean arterial pressure has been significantly greater in Group R than L (66±7 mmHg vs. 62±8 mmHg, $p=0.011$). Sensory onset at T10 and time to peak sensory level at T6 were faster in Group R ($p<0.001$). Group L showed prolonged two-segment regression (101±12 min vs 84±11 min), regression to T10 (125±15 min vs 110±13 min), regression to Modified Bromage score 6 (179±21 min vs 148±18 min), and time to first rescue analgesia (216±28 min vs 182±24 min), all with $p<0.001$. Adverse effects were infrequent and comparable. **Conclusion:** Both drugs provided effective spinal anaesthesia for elective lower segment caesarean section. Ropivacaine offered better mean arterial pressure maintenance and faster sensory onset, whereas levobupivacaine produced longer block duration and prolonged postoperative analgesia.

INTRODUCTION

Subarachnoid block has been extensively employed for LSCS because it delivers rapid onset of anaesthesia, dense sensory blockade, reliable operating conditions while avoiding airway manipulation in parturients.[1] Hyperbaric local anaesthetic solutions are commonly selected in obstetric spinal anaesthesia because their intrathecal spread is more predictable when patient position and dose are standardised.[2]

Spinal anaesthesia-induced hypotension remains a clinically important concern during caesarean delivery. Pregnant women are especially vulnerable because sympathetic blockade occurs against a background of reduced systemic vascular resistance, increased circulating blood volume, and aortocaval compression by gravid uterus.[3] Hypotension and bradycardia may also be aggravated by reflex mechanisms such as the Bezold-Jarisch reflex, which

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is linked to reduced ventricular filling and increased vagal activity.[4,5]

Racemic bupivacaine was traditionally utilized for spinal anaesthesia in caesarean section, but concern regarding dose-related cardiotoxicity and neurotoxicity has encouraged wider use of S-enantiomer local anaesthetics. Experimental and clinical literature has shown that stereoisomeric alternatives may have a more favourable cardiovascular and central nervous system safety profile.[6,7] Levobupivacaine, pure S-enantiomer of bupivacaine, is long-acting local anaesthetic and was used for regional anaesthesia where prolonged sensory blockade is desirable.[7,8]

Ropivacaine is S-enantiomer propyl analogue of bupivacaine. It has lower lipid solubility and relatively lower intrinsic potency, with a tendency to produce less intense motor blockade compared to bupivacaine.[9,10] This property may be useful in obstetric anaesthesia, where faster motor recovery can contribute to early postoperative mobilisation. Yet, in caesarean section, faster recovery must be balanced against the need for adequate intraoperative anaesthesia and sustained postoperative analgesia.

The practical choice between intrathecal hyperbaric levobupivacaine and hyperbaric ropivacaine therefore remains clinically relevant. A drug that maintains maternal haemodynamics more effectively may be useful intraoperatively, whereas a drug that prolongs sensory regression may reduce early analgesic requirement. The present study was undertaken to compare intrathecal hyperbaric levobupivacaine 0.5% and intrathecal hyperbaric ropivacaine 0.75% in parturients undergoing elective LSCS, with emphasis on haemodynamic stability, sensory and motor block characteristics, postoperative analgesia, and adverse effects.

MATERIALS AND METHODS

This prospective comparative, randomised, double-blind clinical study was initiated after approval from "Institutional Ethics Committee of BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, India (IEC BGS GIMS / App/NOV/01/2025-26, dated 01-Dec-2025)". Written informed consent was obtained from all parturients prior to enrolment.

The study included 120 parturients aged 18-40 years, belonging to ASA physical status II, scheduled for elective LSCS under spinal anaesthesia. Before surgery, patients scheduled for elective LSCS underwent a comprehensive pre-anesthetic assessment and relevant haematological evaluations.

Patients fulfilling the eligibility criteria were enrolled after detailed explanation of the anaesthetic technique and study procedure. Standard nil per oral guidelines were followed. Intravenous access was secured using an 18G cannula, and pantoprazole 40 mg was administered intravenously on the morning of surgery. Baseline vital parameters were recorded. In operating room, standard monitors comprising non-invasive blood pressure, electrocardiography, pulse oximetry, and end-tidal CO2 monitoring were connected.

Patients were allocated to two groups using systematic random sampling. Group L received 2.2 mL of 0.5% hyperbaric levobupivacaine, equivalent to 11 mg. Group R received 2.2 mL of 0.75% hyperbaric ropivacaine, equivalent to 16.5 mg.

Subarachnoid block was performed under strict aseptic precautions in the lateral position at L3-L4 interspace using a 25G Quincke spinal needle after local infiltration with 2% lignocaine. After confirming free flow of cerebrospinal fluid, the study drug was administered intrathecally according to group allocation. Oxygen was administered at 5 L/min through a face mask.

Haemodynamic parameters, namely blood pressure, heart rate, and oxygen saturation, were assessed every 3 minutes for the first 15 minutes and subsequently every 5 minutes until completion of surgery. Sensory block onset was assessed by pin-prick using a hypodermic needle. Motor block has been determined using the Modified Bromage score (Table 1). Time to attain maximum sensory and motor block was recorded. Postoperatively, haemodynamic parameters were assessed every 15 minutes for one hour, every 30 minutes for the subsequent 2 hours, and hourly thereafter until complete motor recovery. Time to two-segment regression and time to regression to Modified Bromage score 6 were recorded. Postoperative pain was assessed using "Numerical Rating Scale (NRS: 0-10)". Bradycardia, vomiting, hypotension, nausea, respiratory depression were among side effects that were recorded.

"IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY, USA)" was used for analysis after data entry in Microsoft Excel. Shapiro-Wilk test was used to assess the normality of continuous variables. Variables were summarised as mean±standard deviation or median with interquartile range. Categorical variables were expressed as numbers and percentages. The independent-samples t-test for normally distributed data and Mann-Whitney U-test for non-normally distributed data were used for between-group comparisons for continuous variables. Categorical variables were compared using Fisher's exact test or Chi-square test. Statistical significance was defined as a two-tailed p-value <0.05.

Sample size was calculated using pilot data that showed a mean difference of 4 mmHg in mean arterial pressure between hyperbaric ropivacaine 0.75% and hyperbaric levobupivacaine 0.5% for elective LSCS, with an assumed standard deviation (SD) of 8 mmHg. To detect this difference with 80% power and two-sided alpha of 0.05, the minimum required sample size was 54 participants per group. After allowing for 10% attrition rate, the final target sample size was set at 120 women, with 60 participants in each group.

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RESULTS

All 120 parturients were included in the final analysis, with 60 participants in Group L and 60 participants in Group R. Results are presented according to haemodynamic parameters, sensory and motor block characteristics, postoperative analgesia, and adverse effects.

Haemodynamic parameters

Comparison of haemodynamic parameters showed no statistically significant between-group difference in SBP, DBP, HR, and SpO2. Mean arterial pressure was significantly higher in Group R than in Group L (66±7 mmHg vs 62±8 mmHg, p=0.011), suggesting better maintenance of intraoperative haemodynamic stability with ropivacaine (Table 2 and Figure 1).

Values are displayed as mean±SD. SBP: systolic blood pressure; MAP: mean arterial pressure; DBP: diastolic blood pressure; HR: heart rate; SpO_2: oxygen saturation.

Sensory and motor block characteristics

Group R demonstrated faster onset of sensory block at T10 than Group L (2.0±0.2 min vs 2.2±0.2 min, p<0.001). Time to achieve peak sensory level at T6 was also shorter in Group R (2.6±0.2 min vs 2.8±0.2 min, p<0.001). In contrast, Group L showed significantly prolonged two-segment regression time (101±12 min vs 84±11 min, p<0.001) and longer regression to T10 (125±15 min vs 110±13 min, p<0.001).

Onset of motor block was similar between groups (2.5±0.4 min in Group L vs 2.3±0.4 min in Group R, p=0.07). Time to attain maximum Modified Bromage score also did not differ significantly (2.8±1.2 min vs 2.6±1.0 min, p=0.32). However, regression to Modified Bromage score 6 was significantly prolonged in Group L compared with Group R (179±21 min vs 148±18 min, p<0.001), indicating longer motor block duration with levobupivacaine (Table 3 and Figure 2).

Postoperative analgesia

Time to first rescue analgesia was significantly longer in Group L compared with Group R (216±28 min vs 182±24 min, p<0.001). At six hours, Numerical Rating Scale scores were comparable between the groups (2.2±1.1 vs 2.6±1.2, p=0.07). Diclofenac requirement within 24 hours was also not significantly different between Group L and Group R (34 [57%] vs 38 [63%], p=0.48) (Table 4 and Figure 3).

Adverse effects

Adverse effects were infrequent in both groups. Nausea was observed in 3 (5%) patients in Group L and 2 (3%) patients in Group R (p=0.65). No hypotension, bradycardia, vomiting, or respiratory depression was recorded in either group (Table 5 and Figure 4).

Table 1: Modified Bromage score used for assessment of motor block.

Score	Criteria
1	Complete block, unable to move feet or knees
2	Almost complete block, able to move feet only
3	Partial block, just able to move knees
4	Detectable weakness of hip flexion
5	No detectable weakness of hip flexion while supine, full flexion of knees
6	Able to perform partial knee bend

Modified Bromage score 6 denotes functional motor recovery sufficient to perform partial knee bend.

Table 2: Comparison of haemodynamic parameters between Group L and Group R.

Parameter	Group L: Levobupivacaine (n=60)	Group R: Ropivacaine (n=60)	p-value
Systolic blood pressure (SBP) (mmHg)	90 ± 12	92 ± 10	0.38
Diastolic blood pressure (DBP) (mmHg)	54 ± 9	56 ± 8	0.37
Heart rate (HR) (beats/min)	58 ± 10	62 ± 9	0.22
Mean arterial pressure (MAP) (mmHg)	62 ± 8	66 ± 7	0.011
Oxygen saturation (SpO2) (%)	97 ± 1	98 ± 1	0.28

Values are presented as mean±standard deviation. SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; MAP: mean arterial pressure; SpO2: oxygen saturation.

Table 3: Comparison of sensory and motor block characteristics between Group L and Group R.

Parameter	Group L: Levobupivacaine (n=60)	Group R: Ropivacaine (n=60)	p-value
Onset of sensory block at T10 (min)	2.2 ± 0.2	2.0 ± 0.2	<0.001
Peak sensory level achieved at T6 (min)	2.8 ± 0.2	2.6 ± 0.2	<0.001
Two-segment regression time (min)	101 ± 12	84 ± 11	<0.001

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Time for regression up to T10 (min)	125 ± 15	110 ± 13	<0.001
Onset of motor block (min)	2.5 ± 0.4	2.3 ± 0.4	0.07
Time to attain maximum Modified Bromage score (min)	2.8 ± 1.2	2.6 ± 1.0	0.32
Time to regression to Modified Bromage score 6 (min)	179 ± 21	148 ± 18	<0.001

Values are presented as mean±standard deviation.

Table 4: Comparison of postoperative analgesia between Group L and Group R.

Outcome	Group L: Levobupivacaine (n=60)	Group R: Ropivacaine (n=60)	p-value
Time to first rescue analgesia (min)	216 ± 28	182 ± 24	<0.001
Numerical Rating Scale at 6 h (0-10)	2.2 ± 1.1	2.6 ± 1.2	0.07
Diclofenac requirement within 24 h [n (%)]	34 (57%)	38 (63%)	0.48

Values are presented as mean±standard deviation or number (percentage).

Table 5: Comparison of adverse effects between Group L and Group R.

Adverse effect	Group L: Levobupivacaine (n=60)	Group R: Ropivacaine (n=60)	p-value
Hypotension	0 (0%)	0 (0%)	1.00
Bradycardia	0 (0%)	0 (0%)	1.00
Nausea	3 (5%)	2 (3%)	0.65
Vomiting	0 (0%)	0 (0%)	1.00
Respiratory depression	0 (0%)	0 (0%)	1.00

Values are presented as number (percentage).

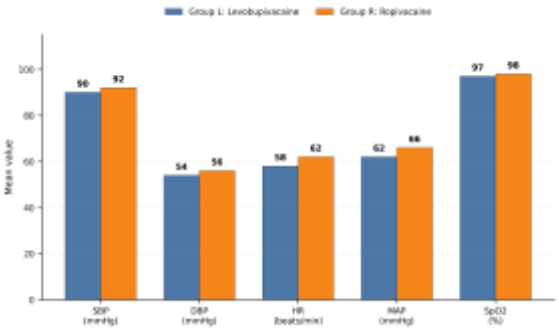

Figure 1: Comparison of haemodynamic parameters between Group L and Group R.

Values are displayed above the bars. MAP was significantly higher in Group R (p=0.011).

Figure 2: Comparison of sensory and motor block characteristics between Group L and Group R.

Values are displayed above the bars. Longer regression times were observed with Group L.

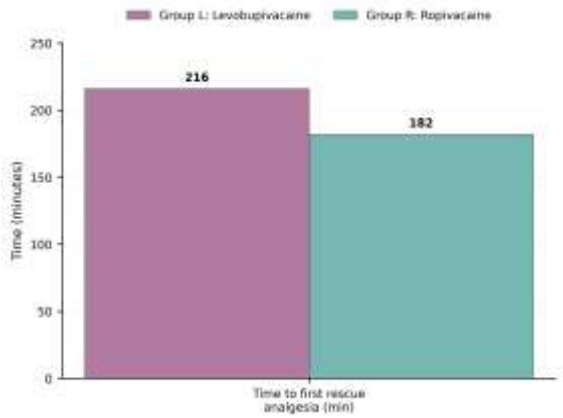

Figure 3: Comparison of time to first rescue analgesia between Group L and Group R.

Values are displayed above the bars. Time to first rescue analgesia was significantly prolonged in Group L (p<0.001).

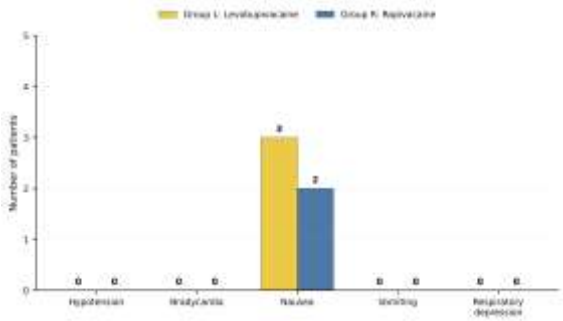

Figure 4: Comparison of adverse effects between Group L and Group R.

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Values are displayed above the bars. No hypotension, bradycardia, vomiting, or respiratory depression was observed.

DISCUSSION

Subarachnoid block continues to be a preferred anaesthetic technique for parturients undergoing LSCS because it provides reliable surgical anaesthesia, effective postoperative analgesia, and avoids several risks associated with general anaesthesia. In the present study, both hyperbaric levobupivacaine and hyperbaric ropivacaine provided satisfactory spinal anaesthesia. The important clinical difference was not failure of block, but the balance between haemodynamic stability, speed of onset, and duration of postoperative analgesia.

Comparison of haemodynamic parameters showed that SBP, DBP, HR, SpO2 were comparable between the two groups. However, MAP was significantly higher in the ropivacaine group. This suggests that ropivacaine preserved intraoperative haemodynamic stability more effectively than levobupivacaine in the studied normotensive parturients. Jain et al., who compared ropivacaine 0.5% plain with levobupivacaine 0.5% plain in gynaecological surgeries, also reported better haemodynamic stability with ropivacaine.[12]

These findings differ from the study by Bhalekar et al., in which intrathecal hyperbaric levobupivacaine 0.5% was considered more favourable than hyperbaric ropivacaine 0.75% in pre-eclamptic parturients undergoing LSCS.[13] This contrast is clinically understandable. Pre-eclampsia is associated with altered vascular tone, endothelial dysfunction, and different baseline haemodynamic responses. Therefore, findings from pre-eclamptic women cannot be directly extrapolated to normotensive parturients.

Ropivacaine demonstrated faster sensory onset and earlier attainment of peak sensory level in the present study. Levobupivacaine, however, produced longer two-segment regression, longer regression to T10, and prolonged regression to Modified Bromage score 6. These findings reflect the expected pharmacological distinction between the 2 agents. Ropivacaine has lower lipid solubility and relatively lower potency, which may contribute to a shorter motor block, while levobupivacaine has a tendency to provide more prolonged sensory and motor blockade. Sharma et al. also reported longer duration of blockade and analgesia with hyperbaric levobupivacaine compared with hyperbaric ropivacaine in infraumbilical surgeries.[14]

The postoperative analgesic profile was also in favour of levobupivacaine, as the time to first rescue analgesia was significantly longer in Group L. However, Numerical Rating Scale scores at six hours and diclofenac requirement within 24 hours were not significantly different. Clinically, this indicates that levobupivacaine delayed the first need for rescue analgesia, although the overall early postoperative analgesic requirement was not very different between groups.

Adverse effects were uncommon in both groups. Nausea occurred in a small proportion of patients and did not differ significantly between groups. No hypotension, bradycardia, vomiting, or respiratory depression was recorded. This finding supports the relative safety of both study drugs when used in the specified intrathecal doses under standard monitoring conditions.

CONCLUSION

Both intrathecal hyperbaric ropivacaine and hyperbaric levobupivacaine provided effective spinal anaesthesia for elective LSCS. Ropivacaine showed better maintenance of mean arterial pressure and faster onset of sensory block. Levobupivacaine provided longer sensory and motor block duration with prolonged time to first rescue analgesia. Therefore, the choice of agent may be guided by whether intraoperative haemodynamic stability or longer postoperative analgesia is the main clinical priority.

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Conflicts of Interest Statement: Nil.

REFERENCES

1. Liu SS, McDonald SB. Current issues in spinal anesthesia. Anesthesiology. 2001;94(5):888-906.
2. Gunusen I, Karaman S, Sargin A, Firat V. A randomized comparison of different doses of intrathecal levobupivacaine combined with fentanyl for elective cesarean section: prospective, double-blinded study. J Anesth. 2011;25(2):205-212.
3. Owczuk R, Wenski W, Polak-Krzeminska A, Twardowski P, Arszułowicz R, Dylczyk-Sommer A, et al. Ondansetron given intravenously attenuates arterial blood pressure drop due to spinal anesthesia: a double-blind, placebo-controlled study. Reg Anesth Pain Med. 2008;33(4):332-339.
4. Aviado DM, Aviado DG. The Bezold-Jarisch reflex: a historical perspective of cardiopulmonary reflexes. Ann N Y Acad Sci. 2001;940:48-58.
5. Yamano M, Ito H, Kamato T, Miyata K. Characteristics of inhibitory effects of serotonin (5-HT)3-receptor antagonists, YM060 and YM114 (KAE-393), on the von Bezold-Jarisch reflex induced by 2-methyl-5-HT, veratridine and electrical stimulation of vagus nerves in anesthetized rats. Jpn J Pharmacol. 1995;69(4):351-356.
6. Clarkson CW, Hondeghem LM. Mechanism for bupivacaine depression of cardiac conduction: fast block of sodium channels during the action potential with slow recovery from block during diastole. Anesthesiology. 1985;62(4):396-405.
7. Bajwa SJ, Kaur J. Clinical profile of levobupivacaine in regional anesthesia: a systematic review. J Anaesthesiol Clin Pharmacol. 2013;29(4):530-539.

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8. Bardsley H, Gristwood R, Baker H, Watson N, Nimmo W. A comparison of the cardiovascular effects of levobupivacaine and rac-bupivacaine following intravenous administration to healthy volunteers. Br J Clin Pharmacol. 1998;46(3):245-249.
9. Wille M. Intrathecal use of ropivacaine: a review. Acta Anaesthesiol Belg. 2004;55(3):251-259.
10. Malinovsky JM, Charles F, Kick O, Lepage JY, Malinge M, Cozian A, et al. Intrathecal anesthesia: ropivacaine versus bupivacaine. Anesth Analg. 2000;91(6):1457-1460.
11. Athar M, Ahmed SM, Ali S, Doley K, Varshney A, Siddiqi MH. Levobupivacaine or ropivacaine: a randomised double blind controlled trial using equipotent doses in spinal anaesthesia. Colomb J Anesthesiol. 2016;44(2):97-104.
12. Jain S, Bendwal HP, Deodhar P, Bhambani P, Romday R, Jain P. Comparative study of ropivacaine (0.5%) plain versus levobupivacaine (0.5%) plain in gynecological surgeries. Int J Reprod Contracept Obstet Gynecol. 2017;6(4):1573-1578.
13. Bhalekar A, Hau R, Singh AK, Nayak AP, Sachan S. A comparative study of intrathecal hyperbaric levobupivacaine and hyperbaric ropivacaine for LSCS in pre-eclampsia parturients. Eur J Cardiovasc Med. 2024;14:355-360.
14. Sharma TH, Jain J, Kishnani P, Tailor R, Thomas S. Comparison of hyperbaric 0.5% levobupivacaine and hyperbaric 0.75% ropivacaine for intrathecal use in infraumbilical surgeries: a randomised clinical study. J Clin Diagn Res. 2025;19(2).

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