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ORIGINAL RESEARCH

Comparative Efficacy of Equivalent Doses of Intrathecal Hyperbaric Levobupivacaine and hyperbaric Bupivacaine in Caesarean section

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ABSTRACT

Background: Subarachnoid block (SAB) occurs quickly and with efficacy, ensuring dependable sensory-motor anaesthesia. The present study compared effectiveness of intrathecal hyperbaric Levo-bupivacaine and hyperbaric bupivacaine for caesarean section.

Materials & Methods: 60 patients aged 18 to 40 years with American Society of Anaesthesiology (ASA) I or II physical status scheduled for caesarean section were randomly divided into two groups of 30 each. Group I received 0.5% hyperbaric bupivacaine of 10 mg and group II received 0.5% hyperbaric levo- bupivacaine of 10 mg for SAB. Parameters such as the time taken to achieve sensory and motor blocks, and adverse events were recorded.

Results: In group I and group II, mean age was 31.2 years and 27.5 years. The mean weight (Kg) was 68.4 and 65.2. The mean height (cm) was 154.2 and 151.6. The mean BMI (Kg/m²) was 29.4 and 28.2. The mean baseline SBP (mm Hg) was 126.4 and 124.8 and baseline heart rate (HR) (beats per minute) was 84.2 and 84.0 respectively. The difference was non- significant (P> 0.05). In group I and group II, mean sensory block (min) was 2.3 and 2.8, motor block (min) was 4.6 and 5.4, regression of sensory (min) was 126.3 and 110.5 and regression of motor (min) was 154.7 and 134.8 respectively. The difference was significant (P< 0.05). Adverse events were pain in 2 in group I and 4 in group II, hypotension 12 in group I and 11 in group II, vomiting 3 in group I and 1 in group II and dose of vasopressor repeated 6 in group I and 2 in group II. The difference was significant (P< 0.05).

Conclusion: The effectiveness of hyperbaric levo-bupivacaine in producing sensory and motor block after intrathecal administration during cesarean delivery is equal to that of hyperbaric bupivacaine. The regression of sensory and motor blocks occurs at a much faster rate with levo-bupivacaine compared to its racemic isomer, bupivacaine.

Keywords: Bupivacaine, Caesarean section, Subarachnoid block

INTRODUCTION

Subarachnoid block (SAB) occurs quickly and with efficacy, ensuring dependable sensory-motor anaesthesia. This is the safest and most common type of anaesthesia used for LSCS, as it avoids the need for general anaesthesia. Pregnant individuals may experience challenges related to airway management and an increased risk of gastric regurgitation and pulmonary aspiration.[1,2] HB is frequently used as a Local Anaesthetic (LA) for CS. A racemic mixture of dextro-bupivacaine and

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levobupivacaine enantiomers is available. Compared to racemic bupivacaine, levo-bupivacaine is a newer isomer available for SAB. It is a very powerful local anesthetic with a slow onset and extended duration of action, offering a more intense sensory block than motor block.[3]

Bupivacaine can lead to cardiac arrest as a result of sympathetic block extension, whereas levo-bupivacaine exhibits quicker protein binding.[4] This characteristic may contribute to a reduction in cardiac toxicity in cases of unintentional intravenous administration. Due to sympathetic block and aorto-caval compression from the gravid uterus during CS, a fall in BP (hypotension) is a common adverse event that occurs in up to 80% of spinal anaesthesia cases.[5] Numerous studies have examined isobaric levo-bupivacaine, both without adjuvants (opioids) and with opioid adjuvants, focusing on safety and clinical effects. However, there are very few studies on hyperbaric levo-bupivacaine. Since 0.5% HB is the drug most often used to induce anaesthesia for CS, and its hyperbaric S (-) enantiomer, levo-bupivacaine, at a dose of 4-12 mg, demonstrates equivalent effectiveness in spinal anaesthesia among healthy volunteers.[6,7] The present study compared effectiveness of intrathecal hyperbaric Levo-bupivacaine and hyperbaric bupivacaine for caesarean section.

MATERIALS AND METHODS

Study Design

This was a prospective, randomized, double-blinded, comparative clinical study aimed at evaluating the effectiveness and safety of intrathecal hyperbaric levo-bupivacaine versus hyperbaric bupivacaine in patients undergoing elective caesarean section.

Study Population

A total of 60 parturients aged 18 to 40 years, belonging to the American Society of Anaesthesiologists (ASA) physical status I or II, scheduled for elective lower segment caesarean section (LSCS) under spinal anaesthesia, were enrolled in the study.

Study place

The study was conducted in the Department of Anaesthesia, Himalaya Medical College, Hospital, Patna, Bihar, India.

Study Duration

The study was conducted over a period of 10 months from March 2024 to December 2024.

Inclusion Criteria

- Pregnant women aged 18–40 years.
- ASA physical status I or II.
- Scheduled for elective LSCS under spinal anaesthesia.
- Gave written informed consent.

Exclusion Criteria

- Patients with contraindications to regional anaesthesia (e.g., coagulopathy, local infection, spinal deformities).
- History of allergy to local anaesthetics.
- Pre-existing neurological, cardiac, or renal disorders.
- Patients with pregnancy-induced hypertension, eclampsia, or pre-eclampsia.
- BMI > 35.
- Emergency caesarean sections.

Ethical Considerations

- The study protocol was approved by the Institutional Ethics Committee prior to initiation.
- All participants provided written informed consent after receiving full information about the nature and risks of the study.
- The study adhered to the Declaration of Helsinki principles for biomedical research involving human subjects.

Study Procedure

- The 60 eligible patients were randomly allocated into two equal groups (n = 30 each) using a computer-generated random number table:
  - Group I: Received 10 mg of 0.5% hyperbaric bupivacaine intrathecally.
  - Group II: Received 10 mg of 0.5% hyperbaric levo-bupivacaine intrathecally.
- Standard spinal anaesthesia technique was used at the L3–L4 or L4–L5 interspace using a 25G Quincke spinal needle.
- After confirming cerebrospinal fluid flow, the drug was administered over 10–15 seconds.
- The anaesthesiologist performing the spinal block and the observer collecting data were both blinded to the group allocation.

Surgical Technique

- All patients underwent elective lower segment caesarean section performed by experienced obstetricians following standard surgical protocols.
- Intraoperative care including oxygen supplementation, IV fluids, and uterotonics was provided as per institutional protocol.

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Outcome Measures

The following parameters were recorded:

- Time to achieve sensory block (measured using pinprick method).
- Time to achieve motor block (assessed using the Modified Bromage Scale).
- Time for regression of sensory block by two segments.
- Time for return of motor function, determined by ability to flex the ankle joint.
- Hemodynamic parameters (heart rate, blood pressure, SpO_2).
- Adverse effects, including hypotension, bradycardia, nausea, vomiting, shivering, pruritus, and headache.

Statistical Analysis

- Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version, 21.0.
- Quantitative variables were expressed as mean ± standard deviation (SD) and compared using Student's t-test.
- Qualitative variables were compared using the Chi-square test or Fisher's exact test as appropriate.
- A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Profile

Parameters	Group I	Group II	P value
Age (years)	31.2	27.5	0.81
Weight (Kg)	68.4	65.2	0.13
Height (cm)	154.2	151.6	0.47
BMI (Kg/m²)	29.4	28.2	0.32
Baseline SBP (mm Hg)	126.4	124.8	0.05
Baseline heart rate (HR) (beats per minute)	84.2	84.0	0.05

Table 1 shows that in group I and group II, mean age was 31.2 years and 27.5 years. The mean weight (Kg) was 68.4 and 65.2. The mean height (cm) was 154.2 and 151.6. The mean BMI (Kg/m²) was 29.4 and 28.2. The mean baseline SBP (mm Hg) was 126.4 and 124.8 and baseline heart rate (HR) (beats per minute) was 84.2 and 84.0 respectively. The difference was non- significant (P> 0.05).

Table 2: Block Parameters

Parameters	Group I	Group II	P value
Sensory block (min)	2.3	2.8	0.14
Motor block (min)	4.6	5.4	0.37
Regression of sensory (min)	126.3	110.5	0.01
Regression of motor (min)	154.7	134.8	0.01

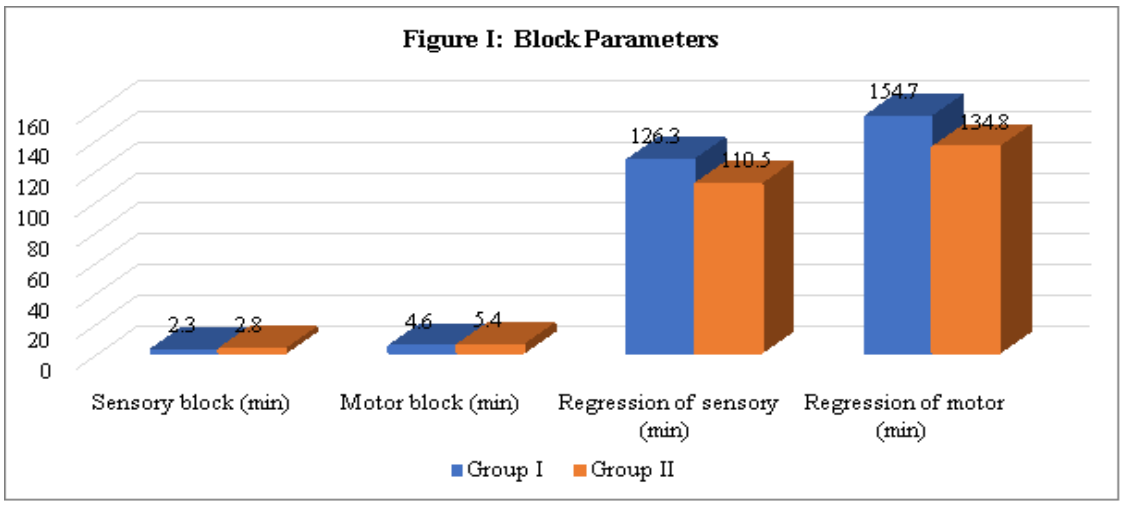

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Table 2, figure I shows that in group I and group II, mean sensory block (min) was 2.3 and 2.8, motor block (min) was 4.6 and 5.4, regression of sensory (min) was 126.3 and 110.5 and regression of motor (min) was 154.7 and 134.8 respectively. The difference was significant (P< 0.05).

Table 3: Evaluation of Adverse Effects

Adverse effects	Group I	Group II	P value
Pain	2	4	0.04
Hypotension	12	11	0.91
Vomiting	3	1	0.02
Dose of vasopressor repeated	6	2	0.01

Table 3 shows that adverse events were pain in 2 in group I and 4 in group II, hypotension 12 in group I and 11 in group II, vomiting 3 in group I and 1 in group II and dose of vasopressor repeated 6 in group I and 2 in group II. The difference was significant (P< 0.05).

DISCUSSION

Many surgical procedures now use spinal anaesthesia as the primary technique. Local anaesthetics induce a reversible regional blockade of sensory nerve impulse conduction, stopping the transmission of sensory information to the CNS while maintaining consciousness.[8] Bupivacaine is the most commonly used local anaesthetic for spinal anaesthesia in caesarean sections worldwide, but it has significant side effects on the cardiovascular and central nervous systems.[9] Bupivacaine, which is a local anaesthetic of the amino amide type, belongs to the n-alkyl substituted pipecoloxylidide family. It has a high lipid solubility and features a chiral centre on the piperidine ring, resulting in two optically active stereo-isomers.[10] The present study compared effectiveness of intrathecal hyperbaric Levo-bupivacaine and hyperbaric bupivacaine for caesarean section.

We found that in group I and group II, mean age was 31.2 years and 27.5 years. The mean weight (Kg) was 68.4and 65.2. The mean height (cm) was 154.2 and 151.6. The mean BMI (Kg/m²) was 29.4 and 28.2. The mean baseline SBP (mm Hg) was 126.4 and 124.8 and baseline heart rate (HR) (beats per minute) was 84.2 and 84.0 respectively. Saring et al[11] compared the effectiveness of hyperbaric levo-bupivacaine to HB in achieving sensory and motor blocks in Caesarean Section (CS) using equivalent doses. The time taken to attain a T6 dermatomal block level was 2.43±1.00 and 2.80±1.51 (p-value 0.08) for the bupivacaine and levo-bupivacaine groups, respectively. Complete motor block of the lower limb was achieved in 4.85±1.67 and 5.15±1.82 (p-value 0.53). However, the time to 2-segment regression for sensory block was significantly faster in the levobupivacaine group than in the bupivacaine group (125.9±28.56 minutes and 109.13±28.84 minutes, respectively, p-value 0.009). Regression from motor block was also found to be highly statistically significant (158.38±34.92 minutes for bupivacaine and 138.75±25.71 minutes for the levo-bupivacaine group, p-value 0.006). Spinal-induced hypotension was comparable in both groups, but the bupivacaine group needed a much higher repetition of dose of vasopressor than the levo-bupivacaine group.

We found that in group I and group II, mean sensory block (min) was 2.3 and 2.8, motor block (min) was 4.6 and 5.4, regression of sensory (min) was 126.3 and 110.5 and regression of motor (min) was 154.7 and 134.8 respectively. Kaur et al[12] compared the effects of 0.5% isobaric levobupivacaine and 0.5% hyperbaric bupivacaine in pregnant females undergoing caesarean section. This study was conducted on 100 pregnant females undergoing caesarean section. They were randomly divided into two groups B and L receiving 2 ml of 0.5% hyperbaric bupivacaine and 0.5% levobupivacaine respectively. Two groups were compared with regard to sensory block, motor block, haemodynamic stability and complications if any. Time to achieve sensory blockade till T6 dermatome was prolonged in group B (162.52±80.55 sec) as compared to group L (139.40±49.79 seconds) (p value= 0.087). Prolonged duration of motor blockade was observed in group B (160.76±6.56 minutes) as compared to group L (131.48±14.42 minutes) (p<0.001). Less haemodynamic stability was seen in patients of group B with more incidence of hypotension and bradycardia.as compared to group L.

We found that adverse events were pain in 2 in group I and 4 in group II, hypotension 12 in group I and 11 in group II, vomiting 3 in group I

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and 1 in group II and dose of vasopressor repeated 6 in group I and 2 in group II. Bremich DH et al[13] compared fixed doses of intrathecal hypertonic levobupivacaine 0.5% (10 mg) and bupivacaine 0.5% (10 mg) combined with either intrathecal fentanyl (10 and 20 microg), or sufentanil (5 microg) in terms of sensory and motor block characteristics. Levobupivacaine produced a significantly shorter and less pronounced motor blockade than racemic bupivacaine regardless of the kind and dose of opioid added. Duration of motor block Bromage 3 was 53 +/- 14 min, 23 +/- 18 min and 41 +/- 8 min compared to 65 +/- 25 min, 70 +/- 19 min and 65 +/- 22 min in the bupivacaine groups. Also, only n = 5/30 parturients reached Bromage 3 in the levobupivacaine groups versus n = 21/30 parturients in the bupivacaine groups. No parturient experienced intraoperative pain. Adding sufentanil 5 microg to either local anaesthetic significantly prolonged duration of effective analgesia compared to supplemental fentanyl 10 or 20 microg.

LIMITATIONS OF THE STUDY

- Small sample size (n = 60), which limits the generalizability of results.
- Single-centre study, which may introduce institutional bias.
- Short-term follow-up; long-term effects or complications were not assessed.
- Exclusion of emergency LSCS patients may limit applicability in urgent clinical scenarios.
- Blinding was not absolute, as differences in drug onset characteristics might have revealed group allocation to experienced observers.
- Adverse effects were noted only perioperatively; no postoperative follow-up data on neurological complications were included.

CONCLUSION

Authors found that the effectiveness of hyperbaric levo-bupivacaine in producing sensory and motor block after intrathecal administration during cesarean delivery is equal to that of hyperbaric bupivacaine. The regression of sensory and motor blocks occurs at a much faster rate with levo-bupivacaine compared to its racemic isomer, bupivacaine.

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