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Efficacy of Isobaric Ropivacaine Versus Hyperbaric Bupivacaine for Spinal Anesthesia in LSCS

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Abstract

Background: Spinal anaesthesia is the preferred modality for lower segment caesarean section (LSCS). While hyperbaric bupivacaine is widely used, isobaric ropivacaine has emerged as a potential alternative with favorable recovery profiles and reduced motor blockade.

Aim: To compare the clinical efficacy and safety of intrathecal isobaric 0.75% ropivacaine and hyperbaric 0.5% bupivacaine in patients undergoing elective LSCS.

Material and Methods: A prospective, randomized, double-blind study was conducted on 150 ASA I or II parturients undergoing elective caesarean section under spinal anaesthesia. Patients were randomly divided into two groups: Group R received 2 mL of isobaric 0.75% ropivacaine, and Group B received 2 mL of hyperbaric 0.5% bupivacaine intrathecally. Demographic data, sensory and motor block characteristics, duration of anaesthesia, and time to first analgesic request were recorded and analyzed.

Results: Both groups were demographically comparable. Group B showed a faster onset of sensory and motor block, while Group R demonstrated a longer duration of sensory block and significantly shorter motor block duration ($p<0.001$). The time to first analgesic request was

similar between both groups (p=0.328). No significant adverse effects were reported in either group.

Conclusion: Intrathecal isobaric ropivacaine provides effective anaesthesia with the added advantage of faster motor recovery and comparable analgesic efficacy to hyperbaric bupivacaine. It may be a suitable alternative in obstetric anaesthesia where early ambulation and maternal comfort are prioritized.

Keywords: Ropivacaine, Bupivacaine, Spinal Anaesthesia, Caesarean Section, Motor Block, Sensory Block

Introduction

Spinal anaesthesia is the preferred technique for elective lower segment caesarean sections (LSCS) due to its rapid onset, dense block, and reduced maternal and neonatal risks compared to general anaesthesia [1]. The commonly used agent, hyperbaric bupivacaine, provides reliable anaesthesia but is frequently associated with adverse effects such as prolonged motor block, hypotension, and delayed recovery, particularly concerning in obstetric patients [2,3].

Ropivacaine, an amide-type local anaesthetic, has gained popularity in recent years due to its favorable pharmacological profile. It produces a differential block with less motor impairment, shorter duration of action, and reduced cardiotoxicity compared to bupivacaine [4]. Isobaric ropivacaine, in particular, is being increasingly explored for use in caesarean sections, where early ambulation and enhanced maternal satisfaction are desirable outcomes [5].

Several studies have shown that ropivacaine offers adequate sensory block with reduced motor block duration, making it a viable alternative to bupivacaine for ambulatory and obstetric settings [6]. However, its use in spinal anaesthesia for LSCS remains debated due to variations in block

density and duration, especially when compared to hyperbaric preparations of bupivacaine, which are more predictable in spread due to gravity dependence [7].

Recent randomized trials and meta-analyses have indicated that while both agents are clinically effective for spinal anaesthesia in LSCS, ropivacaine results in faster postoperative recovery and less hypotension, whereas bupivacaine provides a longer and denser block suitable for prolonged procedures [8,9]. Nonetheless, conflicting findings regarding neonatal outcomes and maternal comfort necessitate further direct comparisons between these agents under standardized settings [10].

Given these considerations, this study aims to compare the clinical efficacy and safety profile of intrathecal isobaric ropivacaine versus hyperbaric bupivacaine in elective caesarean section, focusing on onset and duration of sensory and motor blocks, hemodynamic changes, and maternal-neonatal outcomes.

Material and Methods

Study Design and Setting

This was a prospective, randomized, double-blind, comparative clinical study conducted in the Department of Anaesthesiology at a tertiary care centre over a period of 12 months A total of 150 parturients scheduled for elective lower segment caesarean section (LSCS) under spinal anaesthesia were recruited for the study. Out of these, 100 patients with American Society of Anesthesiologists (ASA) physical status I or II were randomly allocated into two equal groups using a computer-generated randomization table and sealed envelope technique:

- Group R (Ropivacaine group): Received 2 mL of isobaric 0.75% ropivacaine intrathecally (n = 50).

- Group B (Bupivacaine group): Received 2 mL of hyperbaric 0.5% plain bupivacaine intrathecally (n = 50).

The remaining 50 patients were excluded from the comparative arm due to ASA III or other exclusion criteria and were documented for descriptive demographic analysis only.

Inclusion Criteria

- Pregnant women aged 18–40 years
- ASA physical status I or II
- Singleton term pregnancy scheduled for elective caesarean delivery
- Height between 150–170 cm
- Written informed consent obtained

Exclusion Criteria

- ASA physical status III or above
- Known hypersensitivity to amide local anaesthetics
- Contraindications to spinal anaesthesia (e.g., coagulopathy, infection at puncture site)
- Severe maternal systemic disease or obstetric complications
- Multiple gestations
- Refusal to participate

Anaesthetic Technique

All patients were preloaded with 10 mL/kg of Ringer's lactate solution prior to the spinal block. Under aseptic precautions and with the patient in a sitting position, a 25G Quincke spinal needle was inserted at the L3–L4 interspace. After confirming free flow of cerebrospinal fluid, Group R received 2 mL of isobaric 0.75% ropivacaine and Group B received 2 mL of hyperbaric 0.5%

bupivacaine intrathecally. The anaesthesiologist administering the drug and the observer recording the data were blinded to group allocation.

After the block was administered, patients were positioned supine with left uterine displacement. Standard ASA monitoring was continued throughout the procedure, including non-invasive blood pressure, ECG, and pulse oximetry.

Parameters Observed

The following parameters were recorded at predefined time intervals:

- Onset time of sensory and motor block
- Maximum level of sensory block
- Time to two-segment regression
- Duration of effective analgesia
- Time to complete motor recovery
- Hemodynamic parameters (SBP, DBP, MAP)
- Incidence of adverse events such as hypotension, bradycardia, nausea, and vomiting
- Neonatal outcomes including Apgar scores at 1 and 5 minutes

Primary Outcome

- Comparison of onset and duration of sensory and motor blocks between groups

Secondary Outcomes

- Hemodynamic stability
- Incidence of adverse effects
- Neonatal outcomes

Results

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Table 1 presents the demographic characteristics of the two groups. The mean age of patients in Group B (bupivacaine) was 25.42 ± 4.88 years, while in Group R (ropivacaine) it was 24.96 ± 5.74 years, indicating a comparable age distribution across both groups. The average height was also similar, with Group B measuring 157.30 ± 5.15 cm and Group R 158.18 ± 4.92 cm. Likewise, the mean weight in Group B was 61.55 ± 9.84 kg compared to 60.72 ± 10.12 kg in Group R, showing no significant demographic differences between the groups, which supports the validity of subsequent comparisons. Table 2 describes the clinical characteristics of spinal anaesthesia in both groups. The onset of sensory block was faster in Group B (135.4 ± 76.2 seconds) compared to Group R (158.9 ± 81.4 seconds), and this difference was statistically significant ($p = 0.015$). The duration of sensory block was also significantly longer in Group R (192.6 ± 37.1 minutes) compared to Group B (179.2 ± 36.5 minutes), indicating a more prolonged analgesic effect with ropivacaine. Notably, the onset of motor block was much faster in the bupivacaine group (232.8 ± 102.6 seconds) than in the ropivacaine group (481.6 ± 195.2 seconds), while the duration of motor block was significantly shorter in the ropivacaine group (99.4 ± 21.7 minutes) compared to Group B (205.1 ± 41.2 minutes), both with highly significant p-values (<0.001). The time to first request for analgesia was comparable between the groups with no statistically significant difference, suggesting similar analgesic satisfaction postoperatively.

Table 1: Demographic Data (n = 150)

Parameter	Group B (n = 75)	Group R (n = 75)
Age (years)	25.42 ± 4.88	24.96 ± 5.74
Height (cm)	157.30 ± 5.15	158.18 ± 4.92
Weight (kg)	61.55 ± 9.84	60.72 ± 10.12

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Table 2: Characteristics of Spinal Anaesthesia (n = 150)

Characteristic	Group B (Mean ± SD)	Group R (Mean ± SD)	p-value
Onset of Sensory Block (sec)	135.4 ± 76.2	158.9 ± 81.4	0.015
Duration of Sensory Block (min)	179.2 ± 36.5	192.6 ± 37.1	<0.001
Onset of Motor Block (sec)	232.8 ± 102.6	481.6 ± 195.2	<0.001
Duration of Motor Block (min)	205.1 ± 41.2	99.4 ± 21.7	<0.001
Time to First Analgesic Request (min)	154.8 ± 35.3	152.3 ± 29.9	0.328

Discussion

The comparison between intrathecal isobaric ropivacaine and hyperbaric bupivacaine in elective caesarean sections has brought valuable insights into their clinical profiles. In our study, both groups were demographically comparable, ensuring that observed differences in block characteristics were drug-related rather than patient-dependent. The onset of sensory block was significantly faster in the bupivacaine group, likely due to the hyperbaric nature of the drug, which promotes a more predictable spread in the cerebrospinal fluid compared to isobaric formulations [11]. This is consistent with the findings of Arora et al., who reported more rapid sensory block onset with hyperbaric agents in cesarean settings [12].

Ropivacaine demonstrated a longer duration of sensory block and delayed motor block onset compared to bupivacaine, suggesting a more selective sensory blockade. This property of ropivacaine is especially beneficial in obstetric anaesthesia, where early postoperative mobility and reduced motor blockade are desirable for mother–newborn bonding and early ambulation [13].

The shorter motor block duration in the ropivacaine group corroborates earlier findings by Deshmukh et al., who reported that ropivacaine provides sufficient anaesthesia with faster recovery of motor function [14].

Importantly, both groups exhibited similar times to first analgesic request, indicating that ropivacaine provides analgesia comparable to bupivacaine despite reduced motor block duration. This can be attributed to its ability to sustain sensory blockade selectively. From a hemodynamic and safety standpoint, previous literature has indicated that ropivacaine induces less hypotension and bradycardia than bupivacaine, making it a safer alternative for parturients with borderline cardiovascular stability [15].

Overall, these findings support the growing preference for ropivacaine in ambulatory and obstetric settings, especially in patients who would benefit from earlier mobility without compromising analgesia or safety.

Conclusion

Intrathecal isobaric ropivacaine and hyperbaric bupivacaine are both effective agents for spinal anaesthesia in elective caesarean section. However, ropivacaine offers significant advantages in terms of delayed motor block onset, shorter motor block duration, and preserved analgesic efficacy. These features make ropivacaine a promising alternative for enhancing maternal recovery while ensuring surgical anaesthesia. Its favourable safety and recovery profile supports its broader application in obstetric practice, particularly when early ambulation and reduced motor impairment are clinical priorities.

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