

Comparative Evaluation of Intrathecal Administration of Plain Ropivacaine and Bupivacaine in Patients Undergoing Lower Limb Surgeries

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Abstract

Background: Central neuraxial blockade techniques are the most common and popular ones among various regional anesthetic techniques.

Aim: The aim of the study was to assess the efficacy of Bupivacaine 0.5% plain and Ropivacaine 0.5% plain through subarachnoid block for lower limb orthopedic surgeries.

Objectives: The objectives of the study were to compare the quality and duration of anesthesia and analgesia provided by Bupivacaine 0.5% plain and Ropivacaine 0.5% plain for subarachnoid block in lower limb orthopedic surgeries.

Materials and Methods: The present study was conducted in a prospective randomized manner on 50 patients of ASA Grade I and II patients in the age group of 20–50 years scheduled to undergo elective lower limb orthopedic surgeries.

Result: In our study, we found that no significant difference was found in onset and duration of sensory blockade between two groups. However, motor blockade was found of lesser duration with ropivacaine as compared to bupivacaine when used intrathecally. Furthermore, ropivacaine provided better hemodynamic stability.

Conclusion: We conclude that ropivacaine is a better alternative to bupivacaine when used intrathecally as it provides less duration of motor blockade and more hemodynamic stability.

Key words: Bupivacaine, Hemodynamic, Ropivacaine, Subarachnoid block

INTRODUCTION

There has been rapid improvement in the field of regional anesthesia in past few decades. The advantages of regional anesthetic techniques have been extensively studied with better anatomical understanding and rapid advances in local anesthetic pharmacology. Regional anesthesia has

less side effects and fewer complications as compared to general anesthesia, so it is more popular for below umbilical surgeries nowadays.

Regional anesthesia can provide adequate anesthesia neither impairing the consciousness level of the patient nor abolishing the protective airway reflexes in contrast to general anesthetic techniques. Patients can also communicate with the anesthesiologist regarding their problems.

Central neuraxial blockade techniques are the most common and popular ones among various regional anesthetic techniques. It includes the subarachnoid block, the epidural block, and the caudal block.

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Subarachnoid block is probably the most widely used regional anesthetic procedure for below umbilical surgeries in routine clinical anesthesiology (Hinnerk FWW 1998). It provides rapid onset, consistent sensory blockade and adequate muscle relaxation for all types of surgery below the level of the umbilicus. This procedure is relatively easier, requires less equipment and very cost effective. Main disadvantages of the subarachnoid block are hypotension, lack of ability in precisely controlling the level and duration of block and risk of introduction of infection directly into the cerebrospinal fluid (Ronald D. Miller) Table 2.

Epidural block has the advantage to extend the block to desired level and duration. It causes lesser hypotension which is gradual in onset and easier to control. Patients remain hemodynamically more stable with this technique. This procedure is somewhat less popular compared to subarachnoid block due to some limitations with this procedure. More technical expertise is needed for this procedure, and the onset of block is somewhat slow and time consuming. Occasional patchy effect and sacral sparing can also occur. Inadvertent dura puncture with its own consequent problems may result.

Combined spinal epidural block is a time-tested regional anesthetic technique by which advantages of both subarachnoid block and epidural block can be summated, and disadvantages can be attenuated.

Newly introduced long-acting amide local anesthetics like Ropivacaine which is a pure “S” enantiomer of ropivacaine and levobupivacaine which is a levorotatory isomer of bupivacaine have been clinically used for various regional anesthetic procedures. The claimed benefits of reduced cardiovascular toxicity (Markham A, Faulds D [1996], McClellan K.J., Faulds D. [2000], McClellan K.J., Spencer C.M. [1998], Milligan K.R. [2004], Feldman HS, Arthur GR [1989] Gristwood RW *et al.* [2002] Susan E. Copeland *et al.* [2005] Stefania Leone *et al.* [2008]) has received differential comments from various workers. The advantages do not appear clinically significant when the single shot subarachnoid block is considered.

The difference in densities of the two available preparations is believed to affect their diffusion patterns and distribution after injection into the CSF in the subarachnoid space. The diffusion pattern determines the effectiveness, spread (dermatome height or block height), and side effect profile of bupivacaine.^[1]

Hence, this study was designed to determine if ropivacaine really offered any added advantage over the time-tested drug Bupivacaine when used in the subarachnoid block in patients undergoing surgeries below the level of the

umbilicus. Their quality of anesthesia, duration of onset of sensory and motor block, total duration of motor block, regression of sensory block, and associated hemodynamic parameters were recorded and analyzed.

Aims and Objectives

The objectives of the study are as follows:

1. To compare the quality and duration of anesthesia provided by Bupivacaine 0.5% plain and Ropivacaine 0.5% plain for subarachnoid block in lower limb orthopedic surgeries.
2. To compare the duration of post-operative analgesia among the two groups.
3. To evaluate and compare the side effects and complications associated among two groups.

MATERIALS AND METHODS

The present study was conducted in a prospective randomized manner on 50 patients of ASA Grade I and II patients in the age group of 20–50 years in the Department of Anaesthesiology, Shyam Shah Medical College and associated Sanjay Gandhi Memorial Hospital, Rewa, Madhya Pradesh, India, scheduled to undergo elective lower limb orthopedic surgeries.

Selection Criteria

- Patients of age group 20–50 years of ASA I and II physical status.
- Patients of severe stenotic valvular heart disease or ventricular outflow obstruction, severe hypovolemia, severe hypotension, increased intracranial tension, coagulopathy or any other bleeding disorder, infection at the site of injection, and patient refusal for consent were excluded from our study.
- All patients were administered 500 ml ringer lactate solution. Baseline pulse rate, blood pressure, respiratory rate, SPO₂, and electrocardiogram (ECG) were recorded.
- The patients were randomly divided using envelope method into two groups of 25 each:

Group I: Received intrathecal 3 ml 0.5% isobaric Bupivacaine (15 mg).

Group II: Received intrathecal 3 ml 0.5% isobaric Ropivacaine (15 mg).

Continuous monitoring of HR, NIBP (Non invasive blood pressure Non invasive blood pressure), R/R, SPO₂, and ECG was done during intraoperative period and readings noted at regular intervals of 0, 5, 10, 15, 20, 25, 30, 45, 60, 120, 150, 180, 240, 300, 360, and 420 min. Onset of sensory blockade and motor blockade was noted in all the

patients. Determination of onset of sensory block was done by pinprick technique; while assessment of motor blockade was done using Bromage Scale.

Grade 0 - Able to raise the lower limb straight (straight leg raising test).

Grade I - Able to perform knee joint movement but not at the hip joint movement.

Grade II - Able to perform movement at ankle joint but neither at hip joint nor at the knee joint.

Grade III - Able to perform the movement, but unable to perform ankle, knee, and hip joint movement.

Grade IV - No movement at lower limb.

Post-operative H.R, NIBP, R/R, spO₂, and ECG were observed till the requirement of first rescue analgesic dose. Duration of sensory and motor blockade was observed postoperatively, and duration of first rescue analgesia was noted in all the patients.

Patients were observed for side effects such as hypotension, bradycardia, respiratory depression, nausea/vomiting, tightness in chest, respiratory difficulty, and convulsions.

All statistical analysis was done using IBM SPSS ver.20. Observations were duly recorded, tabulated and then statistically analyzed by paired *t*-test between the groups. *P* < 0.05 was considered statistically significant.

RESULTS

All patients were demographically similar in regards to age, sex, and duration of surgery and it can be presumed that the groups were comparable for the purpose of the study.

In our present study, onset of sensory block took 6.36 ± 1.76 for 0.5% bupivacaine and 6.16 ± 1.72 for 0.5% ropivacaine and there was no intergroup significance (*P* < 0.05).

The time to achieve complete motor blockade (Modified Bromage Scale 1) was shorter in the bupivacaine group (11.50 ± 3.272) than the ropivacaine group (15.39 ± 3.166), and the difference was statistically significant (*P* < 0.05).

The duration of sensory block was less in ropivacaine group (200 min) than in bupivacaine (237 min). The duration of motor block was also less in ropivacaine group (170 min) as compared to bupivacaine (218 min).

The decrease in systolic blood pressure in relation to baseline levels was more pronounced in Group I which was consistent with the higher maximum level of sensory blockade in their group.

No significant changes were reported in pulse rate, respiratory rate, and SpO₂ in the present study.

Duration of analgesia was longer in Group I (234.76 ± 11.16) than Group II (202.40 ± 12.64) and was statistically significant (*P* < 0.05).

Most common side effects found in our study were hypotension, bradycardia, and nausea.

DISCUSSION

Regional anesthesia has many advantages over general anesthesia for below umbilical surgeries and is associated with lower incidence of pulmonary and cardiovascular complications, better post-operative pain management, lower incidence of deep vein thrombosis, and pulmonary embolism.^[2]

Subarachnoid block provides rapid onset, consistent sensory blockade and adequate muscle relaxation for all types of surgery below the level of the umbilicus. It is relatively easier, requires less equipment and very cost effective. Main disadvantages of the subarachnoid block are hypotension, lack of ability in precisely controlling the level and duration of block and risk of introduction of infection directly into the cerebrospinal fluid.

In the present study, we used plain 0.5% of bupivacaine and plain 0.5% ropivacaine intrathecally for lower limb orthopedic surgeries.

All patients were demographically similar in regards to age, sex, and duration of surgery and it can be presumed that the groups were comparable for the purpose of the study.

In our study, there was a slight reduction in mean arterial pressure (MAP) after the spinal block in both the groups, however, was significant only in bupivacaine group. In addition, there was a decrease in heart rate after spinal block in both the groups. However, there were no significant intergroup differences. Mantouvalou *et al.* also reported the same observation in their study.^[3] Shesky *et al.* also reported an average maximum decrease in MAP of 9–17% with isobaric bupivacaine within 30 min after the induction of spinal anesthesia, a maximum decrease in heart rate of approximately 8–17% was also observed by them.^[4]

In our present study, onset of sensory block took 6.36 ± 1.76 for 0.5% bupivacaine and 6.16 ± 1.72 for 0.5% ropivacaine and there was no intergroup significance [Table 1].

The time to achieve complete motor blockade (Modified Bromage Scale 1) was shorter in the bupivacaine group (11.50 ± 3.272) than the ropivacaine group (15.39 ± 3.166), and the difference was statistically significant ($P < 0.05$) which is shown in Table 1. Same observation was made by Mantouvalou *et al.*^[3] and Luck *et al.*^[5]

The duration of sensory block was less in ropivacaine group (200 min) than in bupivacaine (237 min). The duration of motor block was also less in ropivacaine group (179 min) as compared to bupivacaine (225 min). Luck *et al.* observed sensory block duration of 210 min, 270 min, and 255 min in ropivacaine, bupivacaine, and levobupivacaine groups, respectively. In their study motor block regression started at 90 min in ropivacaine and 180 min in bupivacaine and levobupivacaine group.^[5] Mantouvalou *et al.* observed sensory block time of 220, 237, and 230 min in ropivacaine, bupivacaine, and levobupivacaine groups, respectively. McNamee *et al.*

compared ropivacaine and bupivacaine at a dose of 17.5 mg and they also found faster recovery from sensory and motor block in ropivacaine group.^[6]

Intraoperative hypotension requiring treatment with I.V. ephedrine occurred more often in the Bupivacaine group (4 patients) than in the Ropivacaine (1 patient). The decrease in systolic blood pressure in relation to baseline levels was more pronounced in Group I which was consistent with the higher maximum level of sensory blockade in their group. Ephedrine which was given when physical signs of low blood pressure were apparent or when systolic blood pressure fell below 90 mmHg was administered in 4 patients in Group I, compared to 1 patient in Group II. No significant changes were reported in pulse rate, respiratory rate, and SpO₂ in the present study. Adverse events such as nausea/vomiting, rigor, and itching were equally distributed in all the groups and statistically insignificant Table 3.

Thus, our results are consistent and coincides with the various studies conducted by Kallio *et al.*,^[7] McNamee *et al.*,^[12] and McClelland *et al.*,^[8] Veering *et al.*,^[9] Mantouvalou *et al.*, Luck *et al.*,^[7] and Gautier *et al.*,^[10] in past. Their conclusions were similar to our current study that intrathecal Ropivacaine 0.5% has shorter sensory and motor block duration than equipotent doses of bupivacaine. Hypotension was more common in bupivacaine group.

Table 1: Onset of sensory and motor block and duration of motor block

Criteria	Mean±SD		P value
	I	II	
Sensory block, onset (min)	6.36±1.38	6.16±1.10	0.6737
Sensory block, duration (min)	237±15.2	200±11.3	0.001
Motor block onset (min)	12.84±2.06	12.16±2.23	0.2768
Motor block duration (min)	225.20±19.17	179.20±32.14	0.0001

SD: Standard deviation

Table 2: Duration of analgesia

Criteria	Mean±SD		P value
	Group I	Group II	
Duration of analgesia (min)	234.76±11.16	202.40±12.64	0.0001

SD: Standard deviation

Table 3: Comparison of incidence of adverse effects

Adverse effects	Number of patients in Group I	Number of patients in Group II
Nausea/vomiting	1	0
Rigor	1	1
Hypotension requiring Vasopressor (>1 bolus of injection ephedrine, 5 mg)	4	1
Itching	0	0
PDPH	0	0

PDPH: Postdural puncture headache, NIBP: Non invasive blood pressure

CONCLUSION

We conclude that intrathecal 0.5% ropivacaine is a good alternative to intrathecal 0.5% bupivacaine as it provides shorter duration of motor and sensory block and provides more hemodynamic stability than Bupivacaine 0.5% intrathecally.

Thus, ropivacaine merits use as a day case anesthesia agent as it produces rapid onset of reliable block providing adequate surgical anesthesia of appropriate duration followed by rapid regression of motor and sensory blocks with minimal side effects.

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