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Original Research Article

A Comparative Study of Intrathecal Ropivacaine with Fentanyl versus Bupivacaine with Fentanyl in Lower Abdominal and Lower Limb Surgeries

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Conflict of interest: Nil

Abstract

Background: Adjuvant intrathecal opioids improve the quality and duration of subarachnoid block. Ropivacaine, a pure S-enantiomer amide local anaesthetic, is proposed to provide comparable analgesia with reduced motor blockade relative to bupivacaine, a property of value in lower abdominal and lower limb surgery where early mobilisation is desirable.

Aim: To compare the sensory and motor block characteristics, duration of postoperative analgesia, haemodynamic stability and adverse-effect profile of intrathecal 0.5% isobaric ropivacaine with fentanyl versus 0.5% hyperbaric bupivacaine with fentanyl.

Methods: In this prospective, randomised, single-blind comparative trial, 60 ASA I–II patients undergoing elective lower abdominal and lower limb surgery were allocated to Group B (bupivacaine 0.5% + fentanyl 25 µg, n = 30) or Group R (ropivacaine 0.5% + fentanyl 25 µg, n = 30). Onset and duration of sensory and motor block, duration of analgesia, haemodynamic parameters and adverse events were recorded and analysed using the independent-samples t-test and Chi-square test ($p < 0.05$ significant).

Results: Sensory and motor block onset were significantly faster in Group B ($p < 0.001$). Group B produced a longer duration of sensory block (198 ± 22 vs 176 ± 20 min), motor block (212 ± 25 vs 168 ± 22 min) and analgesia (268 ± 30 vs 244 ± 28 min). Group R showed greater haemodynamic stability with fewer episodes of hypotension and bradycardia. The groups were demographically comparable.

Conclusion: Ropivacaine with fentanyl provides effective surgical anaesthesia with shorter motor blockade, faster motor recovery and greater haemodynamic stability, making it a favourable alternative to bupivacaine with fentanyl, particularly where early ambulation is advantageous.

Keywords: Ropivacaine; Bupivacaine; Fentanyl; Spinal Anaesthesia; Motor Block; Postoperative Analgesia.

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Introduction

Subarachnoid block is the anaesthetic technique of choice for lower abdominal and lower limb surgery, offering a rapid, reliable and profound block with a high success rate, minimal drug requirement and low cost. It avoids the airway manipulation and systemic drug load of general anaesthesia and provides excellent operating conditions with effective early postoperative analgesia. [1] Bupivacaine, a racemic amino-amide, has for decades been the standard intrathecal agent because of its potent and long-lasting block. However, its dense and prolonged motor blockade may delay mobilisation and discharge, and its greater lipophilicity is associated with a higher potential for cardiotoxicity and, through an extensive sympathetic block, with hypotension and bradycardia. [2,3] Ropivacaine, the pure S(–)-enantiomer of propivacaine, was developed specifically to retain the anaesthetic efficacy of bupivacaine while improving its safety profile. [4] Its lower lipid solubility produces a clinically useful differential blockade in which sensory fibres are blocked preferentially over motor fibres, so that adequate surgical anaesthesia is achieved with comparatively less and shorter-lasting motor impairment. Experimental and clinical data further indicate a wider margin between the doses producing central-nervous-system and

cardiovascular toxicity, making ropivacaine an attractive alternative where haemodynamic stability and early ambulation are priorities. [2,4] Intrathecal opioids act synergistically with local anaesthetics at spinal cord receptors. Fentanyl, a lipophilic μ-agonist, enhances the intensity of intraoperative block and prolongs postoperative analgesia without appreciably lengthening motor recovery or delaying discharge, and permits the use of a lower local-anaesthetic dose. [7,8] Although several studies have compared plain ropivacaine with bupivacaine, data on the ropivacaine–fentanyl combination specifically in the mixed setting of lower abdominal and lower limb surgery remain limited. The present study was therefore undertaken to compare intrathecal 0.5% isobaric ropivacaine with fentanyl against 0.5% hyperbaric bupivacaine with fentanyl, with respect to block characteristics, duration of analgesia, haemodynamic stability and adverse effects.

Materials and Methods

This prospective, randomised, single-blind comparative clinical trial was conducted in the Department of Anaesthesiology, Government General Hospital, Ananthapuramu, over an 18-month period following approval by the Institutional Ethics Committee. Written informed consent was obtained from every participant. Sixty adults aged 18–60 years, of ASA physical status I or II and body weight 50–75 kg, scheduled for elective lower abdominal and lower limb surgery under spinal anaesthesia, were enrolled. Patients with infection at the injection site, coagulopathy or anticoagulant therapy, hypersensitivity to the study drugs, ASA status III–IV, spinal deformity, or a requirement for emergency surgery were excluded.

Following a detailed pre-anaesthetic evaluation and routine investigations, patients were allocated by a computer-generated random number sequence to one of two groups of 30. Group B received 0.5% hyperbaric bupivacaine with fentanyl 25 μg, and Group R received 0.5% isobaric ropivacaine with fentanyl 25 μg. Patients were blinded to group allocation, and the anaesthesiologist administering the block was not involved in postoperative assessment.

In the operating room, baseline heart rate, systolic and diastolic blood pressure, mean arterial pressure and SpO_2 were recorded, and intravenous co-loading with 10–15 ml/kg Ringer's lactate was given through an 18-G cannula. Under strict asepsis, spinal anaesthesia was performed at the L3–L4 interspace in the sitting position with a 25-G Quincke needle, and the allocated drug injected after free flow of cerebrospinal fluid. Sensory block was assessed bilaterally by pin-prick along the mid-clavicular line and motor block by the Modified Bromage scale. Haemodynamic parameters were recorded at baseline and at 5, 10, 20, 30, 45, 60, 75, 90, 120, 150, 180 and 240 minutes.

The primary outcomes were the onset and duration of sensory and motor block and the duration of effective analgesia, defined as the interval from injection until the first report of pain or a Visual Analogue Scale score ≥ 4 necessitating rescue analgesia. Secondary outcomes were haemodynamic stability and the incidence of adverse events (hypotension, bradycardia, nausea, vomiting and pruritus). Data were compiled in Microsoft Excel and analysed with SPSS; continuous variables (mean ± SD) were compared using the independent-samples t-test and categorical variables using the Chi-square test, with $p < 0.05$ taken as statistically significant.

Results

The two groups were well matched for age, sex, height, weight and ASA physical status, with no statistically significant differences (Table 1; $p > 0.05$), confirming comparability at baseline.

Sensory block was established significantly more rapidly in Group B, with a shorter onset time and a shorter time to peak sensory level, and reached a marginally higher median dermatomal level (T6 vs T7). Both two-segment regression and the total duration of sensory block were significantly longer in the bupivacaine group, indicating a more prolonged sensory effect (Table 2; $p < 0.001$).

Motor block likewise developed faster and lasted longer in Group B, whereas Group R showed a slower onset and, importantly, a substantially shorter duration of motor block (168 ± 22 vs 212 ± 25 minutes), corresponding to earlier recovery of motor power and potential for earlier mobilisation. The duration of effective analgesia was modestly longer in Group B (268 ± 30 vs 244 ± 28 minutes; $p = 0.002$), and the number of rescue analgesic doses required in 24 hours was comparable between groups (Table 3).

Haemodynamically, both groups showed the expected fall in heart rate and blood pressure after the block, but the decline was more pronounced in Group B, which reached lower mean values between 10 and 30 minutes before returning towards baseline. Group R maintained more stable heart rate and systolic pressure throughout the intraoperative period (Figures 1 and 2). Adverse events were infrequent and self-limiting in both groups. Hypotension and bradycardia occurred more often with bupivacaine and were managed with fluids, vasopressors or atropine as required, whereas nausea, vomiting and pruritus were comparable and generally attributable to the opioid component (Table 4, Figures 3 and 4).

Table 1: Demographic and Baseline Characteristics

Parameter	Group B (n=30)	Group R (n=30)	p-value
Age (years)	38.4 ± 10.2	39.1 ± 9.8	0.78
Sex (M / F)	18 / 12	17 / 13	0.79
Height (cm)	162.3 ± 7.1	163.0 ± 6.8	0.69
Weight (kg)	62.4 ± 6.9	61.8 ± 7.2	0.74
ASA (I / II)	20 / 10	19 / 11	0.79

Table 2: Sensory Block Characteristics

Sensory parameter	Group B (n=30)	Group R (n=30)	p-value
Onset of sensory block (min)	3.8 ± 1.1	4.6 ± 1.2	< 0.001
Time to peak sensory level (min)	8.2 ± 1.6	9.8 ± 1.9	< 0.001
Peak sensory level (median)	T6	T7	–
Two-segment regression (min)	118 ± 14	102 ± 13	< 0.001
Duration of sensory block (min)	198 ± 22	176 ± 20	< 0.001

Table 3: Motor Block and Postoperative Analgesia

Parameter	Group B (n=30)	Group R (n=30)	p-value
Onset of motor block (min)	5.1 ± 1.3	6.8 ± 1.5	< 0.001
Duration of motor block (min)	212 ± 25	168 ± 22	< 0.001
Duration of analgesia (min)	268 ± 30	244 ± 28	0.002
Rescue analgesic in 24 h (n)	1.8 ± 0.6	2.1 ± 0.7	0.08

Table 4: Adverse Events in Both Groups

Adverse event	Group B, n (%)	Group R, n (%)	p-value
Hypotension	8 (26.7)	4 (13.3)	0.20
Bradycardia	5 (16.7)	2 (6.7)	0.42
Nausea	4 (13.3)	3 (10.0)	0.69
Vomiting	2 (6.7)	1 (3.3)	0.55
Pruritus	3 (10.0)	3 (10.0)	1.00

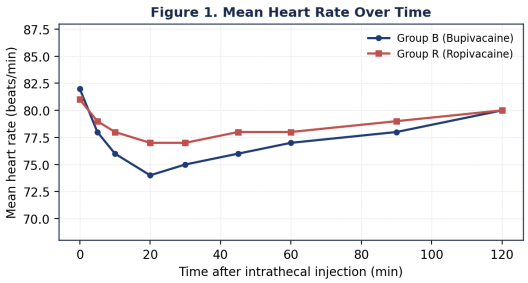

Figure 1.:Mean heart rate over time

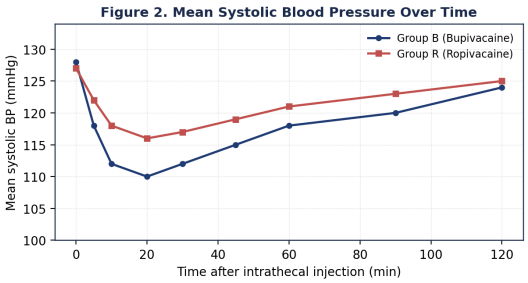

Figure 2: Mean systolic BP over time

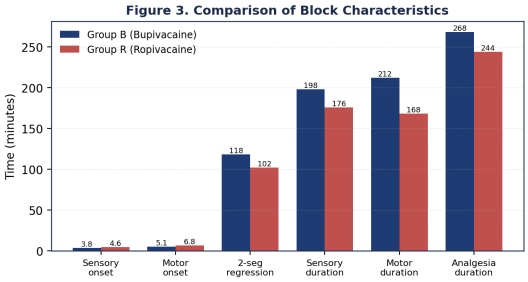

Figure 3: Comparison of block characteristics

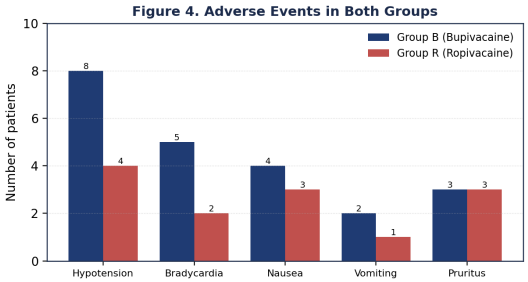

Figure 4: Adverse events in both groups

Discussion

In the present study both intrathecal drug–fentanyl combinations produced satisfactory surgical anaesthesia, but with clearly different block profiles. Bupivacaine produced a faster onset and a longer duration of both sensory and motor block, consistent with its greater potency and lipophilicity, whereas ropivacaine produced a significantly shorter motor block (168 ± 22 vs 212 ± 25 min) with earlier recovery of motor power. This reflects

the recognised sensory-preferential (motor-sparing) action of ropivacaine, which arises from its reduced penetration of the large, heavily myelinated motor fibres relative to the smaller sensory fibres. [2,4]

These observations are in close agreement with Bhat et al [15], who compared intrathecal ropivacaine and bupivacaine specifically for lower abdominal and lower limb surgery and reported a shorter motor block with comparable analgesic efficacy in the ropivacaine group. Kulkarni et al [13] similarly noted a faster onset and a longer motor block with bupivacaine, while ropivacaine allowed earlier ambulation. In classic dose-controlled comparisons, Whiteside et al [9] and Malinovsky et al [6] also found that intrathecal ropivacaine produced a shorter and less intense motor block than an equal dose of bupivacaine, supporting the consistency of this differential effect across surgical populations.

The duration of effective analgesia was only modestly longer with bupivacaine (268 ± 30 vs 244 ± 28 min); the addition of 25 µg fentanyl augmented and prolonged analgesia in both groups through a spinal opioid mechanism, narrowing the gap between the two local anaesthetics while contributing to a comparable, low incidence of pruritus. [7,8] The lower incidence of hypotension and bradycardia and the more stable haemodynamic trends observed with ropivacaine are consistent with its wider cardiovascular safety margin and more gradual onset of sympathetic block3, an advantage also reported by McNamee et al [10]. Such stability is clinically valuable in elderly patients and those with limited cardiovascular reserve.

Taken together, these findings suggest that ropivacaine with fentanyl offers a clinically useful balance—adequate surgical anaesthesia and analgesia combined with faster motor recovery and greater haemodynamic stability—particularly suited to day-care and early-mobilisation pathways, whereas bupivacaine with fentanyl remains advantageous when a longer, denser block is required.

The principal limitations of this study are its single-centre design, modest sample size and single-blind assessment; larger multicentre trials incorporating dose–response evaluation and functional recovery outcomes would help to define the optimal ropivacaine–fentanyl regimen.

Conclusion

Intrathecal ropivacaine with fentanyl provides effective and reliable surgical anaesthesia for lower abdominal and lower limb surgery, with the advantages of a shorter motor block, earlier motor recovery and greater haemodynamic stability compared with bupivacaine with fentanyl. It is therefore a suitable alternative, especially where early ambulation and cardiovascular stability are priorities, while bupivacaine with fentanyl remains preferable when a longer duration of block is desired.

References

1. Kuthiala G, Chaudhary G. Ropivacaine: a review of its pharmacology and clinical use. Indian J Anaesth. 2011;55(2):104-10.
2. McClellan KJ, Faulds D. Ropivacaine: an update of its use in regional anaesthesia. Drugs. 2000;60(5):1065-93.
3. Graf BM, Abraham I, Eberbach N, Kunst G, Stowe DF, Martin E. Differences in cardiotoxicity of bupivacaine and ropivacaine are the result of physicochemical and stereoselective properties. Anesthesiology. 2002;96(6):1427-34.
4. Casati A, Putzu M. Bupivacaine, levobupivacaine and ropivacaine: are they clinically different? Best Pract Res Clin Anaesthesiol. 2005;19(2):247-68.
5. Gautier PE, De Kock M, Van Steenberge A, Poth N, Lahaye-Goffart B, Fanard L, et al. Intrathecal ropivacaine for ambulatory surgery. Anesthesiology. 1999;91(5):1239-45.
6. Malinovsky JM, Charles F, Kick O, Lepage JY, Malinge M, Cozian A, et al. Intrathecal anesthesia: ropivacaine versus bupivacaine. Anesth Analg. 2000;91(6):1457-60.
7. Cousins MJ, Mather LE. Intrathecal and epidural administration of opioids. Anesthesiology. 1984;61(3):276-310.
8. Hunt CO, Naulty JS, Bader AM, Hauch MA, Vartikar JV, Datta S, et al. Perioperative analgesia with subarachnoid fentanyl-bupivacaine for cesarean delivery. Anesthesiology. 1989;71(4):535-40.
9. Whiteside JB, Burke D, Wildsmith JAW. Comparison of ropivacaine 0.5% (in glucose 5%) with bupivacaine 0.5% (in glucose 8%) for spinal anaesthesia for elective surgery. Br J Anaesth. 2003;90(3):304-8.
10. McNamee DA, McClelland AM, Scott S, Milligan KR, Westman L, Gustafsson U. Spinal anaesthesia: comparison of plain ropivacaine 5 mg/ml with bupivacaine 5 mg/ml for major orthopaedic surgery. Br J Anaesth. 2002;89(5):702-6.
11. Mantouvalou M, Ralli S, Arnaoutoglou H, Tziris G, Papadopoulos G. Spinal anesthesia: comparison of plain ropivacaine, bupivacaine and levobupivacaine for lower abdominal surgery. Acta Anaesthesiol Belg. 2008;59(2):65-71.
12. Luck JF, Fettes PD, Wildsmith JAW. Spinal anaesthesia for elective surgery: a comparison of hyperbaric solutions of racemic bupivacaine,

levobupivacaine, and ropivacaine. Br J Anaesth. 2008;101(5):705-10.
13. Kulkarni KR, Deshpande S, Namazi I, Singh SK, Kondilya K. A comparative evaluation of hyperbaric ropivacaine and hyperbaric bupivacaine for subarachnoid block in lower limb surgeries. Anesth Essays Res. 2014;8(1): 38-43.
14. Cappelleri G, Aldegheri G, Danelli G, Marchetti C, Nuzzi M, Iannandrea G, et al. Spinal anesthesia with hyperbaric levobupivacaine and ropivacaine for outpatient knee arthroscopy: a prospective, randomized, double-blind study. Anesth Analg. 2005; 101(1):77-82.
15. Bhat SN, Himaldev, Upadya M. Comparison of efficacy and safety of ropivacaine with bupivacaine for intrathecal anesthesia for lower abdominal and lower limb surgeries. Anesth Essays Res. 2013;7(3):381-5.