Section: Anaesthesia & Critical Care

Original Research Article

COMPARISON OF INTRATHECAL 0.5% HYPERBARIC BUPIVACAINE PLUS FENTANYL WITH 0.75% HYPERBARIC ROPIVACAINE PLUS FENTANYL IN LOWER LIMB AND LOWER ABDOMINAL SURGERIES

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ABSTRACT

Background: Spinal anaesthesia is widely used for lower abdominal and limb surgeries. While hyperbaric bupivacaine provides effective, long-lasting anaesthesia, it may delay recovery and cause haemodynamic instability. Hyperbaric ropivacaine with fentanyl offers similar efficacy, better stability, and faster recovery. **Objective:** To compare the block characteristics, haemodynamic changes, and adverse effects of intrathecal 0.5% hyperbaric bupivacaine plus fentanyl and 0.75% hyperbaric ropivacaine plus fentanyl. **Materials and Methods:** A prospective, randomised, double-blinded study was conducted on 60 patients undergoing lower abdominal and lower limb surgeries, who were divided into two groups of 30 each: Group B (bupivacaine + 25 µg fentanyl) and Group R (ropivacaine + 25 µg fentanyl). The sensory and motor block parameters, vital signs, and complications were monitored. **Result:** Group B showed faster sensory onset (2.77 ± 0.73 vs. 3.70 ± 0.79 min; p = 0.004), earlier motor onset (11.27 ± 1.17 vs. 13.73 ± 0.94 min; p = 0.003), and longer sensory (198.97 ± 6.75 vs. 151.27 ± 5.39 min; p = 0.002) and motor block durations (192.50 ± 6.80 vs. 124.47 ± 1.98 min; p = 0.002). Group R had better haemodynamic stability with higher systolic (5 min: 110.93 ± 12.79 vs. 101.00 ± 8.77 mmHg; p = 0.001), diastolic (70.00 ± 6.88 vs. 64.07 ± 5.46 mmHg; p = 0.046), and MAP and lower heart rate (77.43 ± 6.09 vs. 87.80 ± 7.80 bpm; p <0.001). Hypotension (20.0% vs. 8.3%; p = 0.045), nausea, bradycardia, and shivering were more frequent in Group B. Group R had more patients without complications (33.3% vs. 21.7%). **Conclusion:** Bupivacaine-fentanyl provided a faster onset and longer block but caused more haemodynamic fluctuations and adverse events. Ropivacaine-fentanyl ensured better stability and faster recovery, supporting its use in short-or ambulatory procedures.

INTRODUCTION

Spinal anaesthesia is frequently chosen for procedures on the lower abdomen and legs because it acts rapidly, provides effective numbness and muscle relaxation, and minimally affects other body systems. Traditionally, 0.5% hyperbaric bupivacaine has been the drug of choice because of its consistent and long-lasting effects. However, it can lead to slower motor recovery and cardiovascular side effects, which are not ideal for short-stay or outpatient procedures.[1,2] Ropivacaine, a newer local anaesthetic of the amino-amide group, provides a similar sensory block but with less motor block and a reduced risk of heart-related side effects. Its 0.75% hyperbaric form enhances spread within the cerebrospinal fluid, providing consistent block height and quicker motor recovery, which is beneficial in fast-track surgery settings.[3,4]

The addition of intrathecal fentanyl, a lipophilic opioid, enhances the anaesthetic quality and prolongs postoperative analgesia without significantly prolonging motor block or increasing complications.[5] Several clinical trials have explored

the effectiveness of combining bupivacaine or ropivacaine with fentanyl for regional anaesthesia, assessing their impact on block characteristics and patient outcomes. One study reported that the ropivacaine-fentanyl combination produced a sensory block similar to that of bupivacaine-fentanyl but allowed quicker motor function recovery during lower limb orthopaedic procedures.[6] Another study noted that in urological surgeries, the motor block lasted for a shorter duration with ropivacaine-fentanyl compared to bupivacaine-fentanyl.[7] In another study, reduced motor block intensity with ropivacaine in transurethral resection procedures.[8]

Adding fentanyl to hyperbaric ropivacaine prolonged analgesia without increasing the motor block duration.[9] In lower limb surgeries, combining ropivacaine with fentanyl leads to quicker recovery of both sensory and motor function, along with more stable haemodynamic parameters, when compared to the bupivacaine-fentanyl pairing. Research involving patients undergoing lower abdominal and lower limb operations has shown that the ropivacaine-fentanyl mixture produces a shorter duration of sensory and motor block while maintaining stable vital signs.[10] Another study also supported the use of intrathecal ropivacaine-fentanyl, reporting faster motor recovery and a more favourable block profile than bupivacaine-fentanyl in infra-umbilical orthopaedic surgeries.[11]

Due to the increasing focus on early mobilisation and quicker discharge, this study aimed to compare intrathecal 0.5% hyperbaric bupivacaine with fentanyl to 0.75% hyperbaric ropivacaine with fentanyl in lower limb and lower abdominal procedures. The main outcomes assessed were time to achieve and maintain sensory and motor block, stability of vital signs, quality of pain control after surgery, and speed of patient recovery.

MATERIALS AND METHODS

This prospective, randomised, double-blind study involved 60 patients and was conducted over one year at ESIC Medical College, Chennai. Institutional Ethics Committee approval was obtained, and informed consent was collected from all patients before enrolment.

Inclusion and exclusion criteria

Individuals aged 18–60 years with ASA physical status I or II, who were scheduled for elective procedures on the lower abdomen or limbs using spinal anaesthesia, were included in the study. The exclusion criteria comprised refusal to participate, allergies to local anaesthetics, spinal abnormalities, pregnancy or breastfeeding, and any contraindications to spinal anaesthesia, such as coagulopathy, use of blood thinners, or infection at the intended puncture site.

Methods

A total of 60 patients were randomly divided into two sets of 30 using a computer-generated randomization table. The allocation for each participant was kept confidential in sealed and opaque envelopes. The study maintained double blinding, with both the patients and the observer collecting data unaware of the drug administered. Spinal anaesthesia was performed by a separate anaesthesiologist who was not involved in data collection.

Patients in the bupivacaine set B received 3 ml of 0.5% hyperbaric bupivacaine (with 80 mg/ml dextrose) plus 0.5 ml fentanyl (25 µg). Those in the ropivacaine set R were given 3 ml of 0.75% hyperbaric ropivacaine (with 80 mg/ml dextrose) along with 0.5 ml fentanyl (25 µg). Before administering spinal anaesthesia, all participants were preloaded with intravenous Ringer's lactate at a dose of 10 ml/kg. Subarachnoid injection was performed at the L3–L4 interspace using a 26G Quincke needle under strict aseptic technique with the patient seated. Following the injection, the patients were positioned supine and continuously monitored throughout the procedure.

The time from intrathecal injection to the loss of pinprick sensation at the T10 dermatome was recorded as the onset of the sensory block. Motor block onset was determined by the interval until complete immobility of the lower limbs, as evaluated using the Modified Bromage Scale. The highest level of sensory block achieved, duration of both sensory and motor block, and time to the first request for additional pain relief were documented. Vital parameters, including heart rate, blood pressure, and oxygen saturation, were tracked before and after the administration of spinal anaesthesia. Adverse events, such as hypotension, bradycardia, nausea, vomiting, itching, shivering, or respiratory difficulties, were observed and managed as needed.

Statistical Analysis

Statistical analyses were conducted using SPSS version 21. Continuous data are presented as mean ± standard deviation and were compared between groups using the independent Student's t-test. Categorical data were evaluated using the chi-square test. A p-value of < 0.05 was considered to indicate statistical significance.

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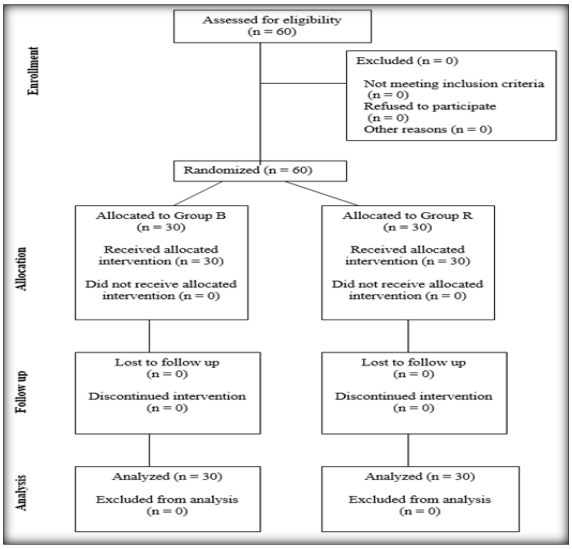

Figure 1: Consort flow diagram

RESULTS

Sixty patients were equally distributed between groups B (n=30, 50%) and R (n=30, 50%). Most patients were aged 26–35 years (31.7%), followed by those aged 46–55 years (25.0%), 36–45 years (20%), and 18–25 years (16.7%), with the least representation in the >55 age group (6.7%). In total, 33 (55%) were male, and 27 (45%) were female. The ASA physical status was evenly distributed, with 31 patients (51.7%) classified as ASA II and 29 (48.3%) as ASA I (Table 1). The average age was 37.80 ± 11.53 years. The average height was 158.47 ± 6.21 cm, mean weight was 67.38 ± 10.34 kg, and mean BMI was 26.74 ± 3.14 kg/m².

Table 1: Baseline Demographics

Parameter	Categories	N (%)
Age Group (years)	18–25	10 (16.7%)
	26–35	19 (31.7%)
	36–45	12 (20%)
	46–55	15 (25%)
	>55	4 (6.7%)
Sex	Female	27 (45%)
	Male	33 (55%)
ASA Physical Status	ASA I	29 (48.3%)
	ASA II	31 (51.7%)

Group B showed a faster onset of sensory block (2.77 ± 0.728 min) than Group R (3.70 ± 0.794 min) (p = 0.004). The sensory block duration was longer in Group B (198.97 ± 6.749 min) than in Group R (151.27 ± 5.394 min) (p = 0.002). The time to complete the motor block was shorter in Group B (11.27 ± 1.172 min) than in Group R (13.73 ± 0.944 min) (p = 0.003). Motor block duration was also longer in group B (192.50 ± 6.801 min) than in group R (124.47 ± 1.978 min) (p = 0.002) (Table 2).

Table 2: Comparison of onset and duration of sensory and motor block between the groups

Parameter	Group B	Group R	p-value
Onset of Sensory Block (min)	2.77 ± 0.728	3.70 ± 0.794	0.004
Duration of Sensory Block (min)	198.97 ± 6.749	151.27 ± 5.394	0.002
Time to Complete Motor Block (min)	11.27 ± 1.172	13.73 ± 0.944	0.003
Duration of Motor Block (min)	192.50 ± 6.801	124.47 ± 1.978	0.002

Hypotension was significantly more frequent among bupivacaine patients (n=12, 20%) than among ropivacaine patients (n=5, 8.3%) (p = 0.045). Bradycardia occurred in 4 bupivacaine patients (6.7%) and 3 ropivacaine patients (5%), with no significant difference (p = 0.688). Nausea was reported by 5 bupivacaine patients (8.3%) and 2 ropivacaine patients (3.3%) (p = 0.228). Shivering was observed in 4 bupivacaine patients (6.7%) and 2 ropivacaine patients (3.3%) (p = 0.389). More patients in the ropivacaine group (n=20, 33.3%) experienced no adverse effects than those in the bupivacaine group (n=13, 21.7%), with no significant difference (p = 0.069) (Table 3).

Table 3: Incidence of complications between the groups

Complications	Group B (n=30)	Group R (n=30)	p-value
Bradycardia	4 (6.7%)	3 (5%)	0.688
Hypotension	12 (20%)	5 (8.3%)	0.045
Nausea	5 (8.3%)	2 (3.3%)	0.228
Shivering	4 (6.7%)	2 (3.3%)	0.389
No complications	13 (21.7%)	20 (33.3%)	0.069

The mean preoperative heart rate was lower in R (77.43 ± 6.09 bpm) than in B (87.80 ± 7.80 bpm) (p < 0.001). At 1 min, the mean heart rate in Group R was 75.13 ± 5.10 bpm, while Group B recorded 87.03 ± 10.01 bpm (p = 0.002). Similar significant differences were observed at 3 min (75.30 ± 7.45 vs. 85.77 ± 12.27 bpm, p = 0.040) and 5 min (77.30 ± 13.72 vs. 85.20 ± 15.66 bpm, p = 0.003). As the

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intraoperative period progressed, heart rates continued to be consistently lower in Group R than in Group B, with significant differences noted at 10, 15, 30, 45, 60, 75, 90, and 120 min (all $p < 0.05$) (Figure 2).

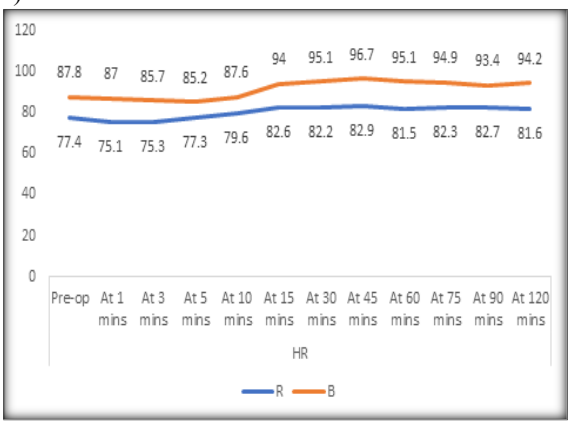

Figure 2: Comparison of heart rate between the groups

Preoperative systolic blood pressure (SBP) was significantly higher in Group R (127.33 ± 13.43 mmHg) than in Group B (122.37 ± 11.31 mmHg) ($p = 0.001$). At 1 min, Group R recorded a mean SBP of 122.10 ± 9.82 mmHg, whereas Group B had 115.23 ± 10.47 mmHg ($p = 0.001$). significant differences were noted at 3 min (116.07 ± 11.14 vs. 107.97 ± 7.62 mmHg, $p = 0.006$) and at 5 min (110.93 ± 12.79 vs. 101.00 ± 8.77 mmHg, $p = 0.001$). Group R maintained higher systolic values throughout the monitoring period, with significant differences at 10, 15, 45, 60, 75, 90, and 120 min ($p < 0.05$). However, at 30 min, the difference in SBP between the groups (117.07 ± 9.61 mmHg in R vs. 110.03 ± 7.77 mmHg in B) was not significant ($p = 0.144$) (Figure 3).

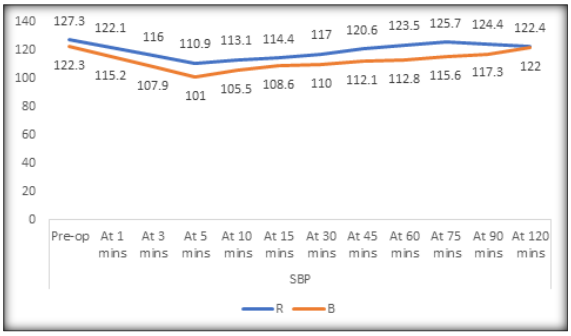

Figure 3: Comparison of SBP between groups

The mean preoperative diastolic blood pressure (DBP) was slightly lower in Group R (76.03 ± 8.16 mmHg) than in Group B (79.33 ± 6.41 mmHg), with a significant difference ($p = 0.002$). At 1 min postoperatively, both groups showed comparable DBP values (73.37 ± 6.53 mmHg in Group R vs. 73.77 ± 6.97 mmHg in Group B), although the difference remained significant ($p = 0.002$). From 3 min onwards, Group B consistently showed lower diastolic pressures than Group R. Significant differences were observed at 3 minutes (67.97 ± 5.34 vs. 71.97 ± 6.83 mmHg, $p = 0.004$), 5 minutes (64.07 ± 5.46 vs. 70.00 ± 6.88 mmHg, $p = 0.046$), and 10 minutes (66.57 ± 8.50 vs. 68.07 ± 6.81 mmHg, $p = 0.005$). Although the difference was not significant at 15 min ($p = 0.122$) and 45 min ($p = 0.064$), significant variations were observed at 30, 60, 75, 90, and 120 min (all $p < 0.05$), with Group B continuing to demonstrate lower DBP values than Group R (Figure 4).

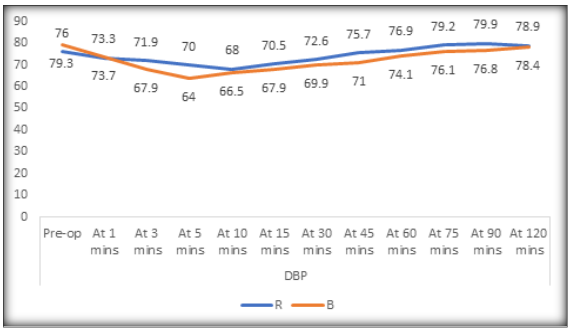

Figure 4: Comparison of DBP between groups

Ropivacaine maintained significantly higher MAP values than bupivacaine at multiple intraoperative time points. Significant differences were observed at 1, 3, 5, 10, 15, 30, 45, 60, 90, and 120 min ($p < 0.05$), but no difference was observed at 75 min ($p = 0.065$).

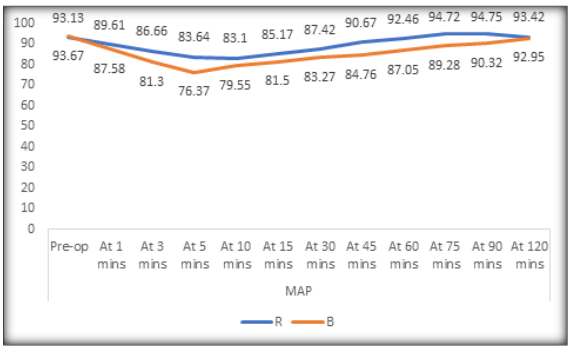

Figure 5: Comparison of MAP between groups

Baseline oxygen saturation was similar among patients receiving either ropivacaine or bupivacaine, with no differences observed at any time during surgery. Oxygen saturation remained consistently above 98% throughout the procedure in both groups of patients (Figure 6).

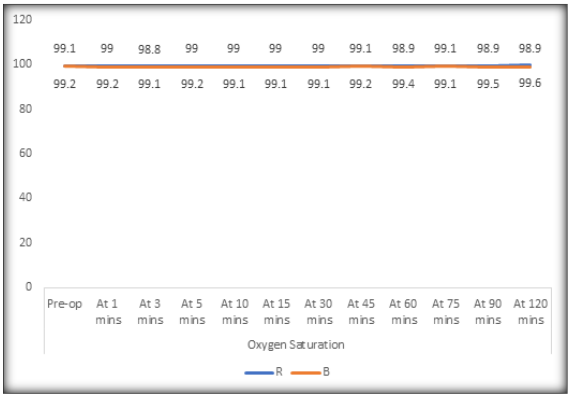

Figure 6: Oxygen saturation levels between groups

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DISCUSSION

In our study, intrathecal 0.5% hyperbaric bupivacaine plus fentanyl was compared with 0.75% hyperbaric ropivacaine plus fentanyl for lower abdominal and lower limb surgery. Of the 60 patients enrolled, 33 (55%) were male and 27 (45%) were female, indicating a slight predominance of male patients. Most patients were in the 26–35 and 46–55-year age groups. The ASA physical status classification was comparable between the groups. The mean BMI was 26.74 kg/m² and the mean height was 158.47 cm.

These demographic characteristics are consistent with the findings reported by Varun et al., who noted a similar gender distribution in their bupivacaine and ropivacaine groups (31 males and 19 females in the bupivacaine group; 25 males and 25 females in the ropivacaine group), with no significant differences between groups.[12] Rathod et al. reported a mean age of 35.75 years among patients receiving spinal anaesthesia for lower limb surgeries,[13] and Singh et al. found that most patients were aged between 30 and 50 years, aligning with our age distribution.[14]

The slight male predominance in our study is also comparable to the 52% male proportion reported by Jivanbhai and Patel, who observed a near-equal distribution of ASA I and II classifications.[15] Wang et al. demonstrated no dosing difference across BMI categories (<25, 25–29.9, ≥30) but noted increased hypotension in patients with BMI ≥30, suggesting stable outcomes in non-obese individuals.[16] Sujatha et al. reported a mean participant height of 159 cm, similar to the mean height in our study, and found no adverse haemodynamic impact related to height or BMI.[17]

In our study, the duration of motor block was significantly longer in the bupivacaine group (192.50 min) than in the ropivacaine group (124.47 min). The sensory block lasted longer in the bupivacaine group (198.97 min) than in the ropivacaine group (151.27 min). The results are in line with Bakshi et al., who also found that intrathecal bupivacaine (206.83 ± 29.13) min produced a significantly longer motor block duration than ropivacaine (158.49 ± 43.25 min), supporting its utility for prolonged surgical procedures.[18] A study by Vyas et al. reported that sensory block onset was faster with bupivacaine (2.77 min) than with ropivacaine (3.70 min), and also found bupivacaine to have a quicker onset when used with fentanyl.[19] Singh et al. noted prolonged sensory blockade (Group RF - 233.1 ± 19.15 min, Group BF - 226.41 ± 17.38 min).[13] These block characteristics suggest that bupivacaine is better suited for longer surgeries, whereas ropivacaine may be advantageous when faster recovery is desired.

Regarding the haemodynamic effects, heart rates were more stable in the ropivacaine group than in the bupivacaine group. The ropivacaine group consistently maintained higher SBP and DBP across 120 min, particularly at 5 min post-spinal injection. MAP remained comparable between the groups throughout the procedure, with no significant difference. This is comparable with study by Nath et al., who reported significantly higher SBP and DBP in the ropivacaine group, with lower SBP in the bupivacaine group at all points, and higher DBP in the ropivacaine group at 4 and 6 min ($p < 0.001$ and $p = 0.005$, respectively), similarly reported a significantly higher MAP in the bupivacaine group at 2 min (93.29 ± 10.02 mmHg vs. 89.25 ± 8.97 mmHg.[20] Shah et al., who reported consistently stable heart rate values with ropivacaine combined with fentanyl in geriatric patients (e.g., 62.73 ± 5.90, 64.10 ± 6.21, 62.93 ± 6.09, 62.33 ± 5.77, and 62.61 ± 5.87 bpm), indicating better haemodynamic control with ropivacaine, which align with our study.[21]

In our study, hypotension was the most common complication, observed in 33.3% of patients, with a higher incidence in the bupivacaine group. Nausea and shivering were reported in 13.3% of patients. Notably, 33 of the 60 patients (55%) had no complications during the study. Similarly, that bradycardia occurred in 16.7% of our cases, which is comparable to the 10% bradycardia reported in the bupivacaine group reported by Vyas et al.[19] Likewise, Surana et al., assessing intrathecal bupivacaine with and without fentanyl, observed a shivering incidence of 0% (0/30) in the bupivacaine–fentanyl group versus 13.3% (4/30) in the bupivacaine-only group, while nausea was reported in 3.3% (1/30) and 6.7% (2/30) of patients, respectively.[22] Also, Vampugalla et al. reported that out of 60 patients, 45 had no complications.[23] Our findings support the use of ropivacaine-fentanyl for procedures where stable haemodynamics and faster recovery are desired, while bupivacaine-fentanyl remains suitable for longer surgeries requiring extended block duration.

Limitations

The study was conducted at a single tertiary care facility with 60 patients, which may limit the applicability of the results to a broader population. Only ASA I and II patients were enrolled, excluding individuals with higher surgical risk, and the study did not assess long-term outcomes or patient satisfaction beyond the immediate postoperative period.

CONCLUSION

The combination of intrathecal 0.5% hyperbaric bupivacaine with fentanyl produced a longer duration of motor and sensory block, faster onset of both blocks, and higher haemodynamic variability than 0.75% hyperbaric ropivacaine with fentanyl. Although bupivacaine provided more prolonged anaesthesia, ropivacaine was associated with better cardiovascular stability and shorter block durations, which may favour its use in ambulatory settings. These findings support the clinical relevance of

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choosing an anaesthetic agent based on procedural requirements and patient profiles.

REFERENCES

1. McNamee DA, Parks L, McClelland AM, Scott S, Milligan KR, Ahlén K, et al. Intrathecal ropivacaine for total hip arthroplasty: double-blind comparative study with isobaric 7.5 mg ml(-1) and 10 mg ml(-1) solutions. Br J Anaesth 2001;87:743–7. https://doi.org/10.1093/bja/87.5.743.
2. Kallio H, Snäll E-VT, Suvanto SJ, Tuomas CA, Iivonen MK, Pokki J-P, et al. Spinal hyperbaric ropivacaine-fentanyl for day-surgery. Reg Anesth Pain Med 2005;30:48–54. https://doi.org/10.1016/j.rapm.2004.11.002.
3. Koltka K, Uludag E, Senturk M, Yavru A, Karadeniz M, Sengul T, et al. Comparison of equipotent doses of ropivacaine-fentanyl and bupivacaine-fentanyl in spinal anaesthesia for lower abdominal surgery. Anaesth Intensive Care 2009;37:923–8. https://doi.org/10.1177/0310057X0903700606.
4. Sırajuddin M, Mehveen H, Qurrum M, Tanveer S. Intrathecal fentanyl with ropivacaine vs bupivacaine in lower limb surgeries: faster recovery and stable haemodynamics. Int J Acad Med Pharm. 2023;5(6):400–4. https://academicmed.org/Uploads/Volume5Issue6/84.%20%5B1914.%20JAMP_Hafsa%20Mehveen%5D%20400-405.pdf
5. Yegin A, Sanli S, Hadimioglu N, Akbas M, Karsli B. Intrathecal fentanyl added to hyperbaric ropivacaine for transurethral resection of the prostate. Acta Anaesthesiol Scand 2005;49:401–5. https://doi.org/10.1111/j.1399-6576.2005.00607.x.
6. Jagtap S, Chhabra A, Dawoodi S, Jain A. Comparison of intrathecal ropivacaine-fentanyl and bupivacaine-fentanyl for major lower limb orthopaedic surgery: A randomised double-blind study. Indian J Anaesth 2014;58:442–6. https://doi.org/10.4103/0019-5049.138985.
7. Lee YY, Ngan Kee WD, Muchhal K, Chan CK. Randomized double-blind comparison of ropivacaine-fentanyl and bupivacaine-fentanyl for spinal anaesthesia for urological surgery. Acta Anaesthesiol Scand 2005;49:1477–82. https://doi.org/10.1111/j.1399-6576.2005.00864.x.
8. Malinovsky JM, Charles F, Kick O, Lepage JY, Malinge M, Cozian A, et al. Intrathecal anesthesia: ropivacaine versus bupivacaine. Anesth Analg 2000;91:1457–60. https://doi.org/10.1097/00000539-200012000-00030.
9. Yegin A, Sanli S, Hadimioglu N, Akbas M, Karsli B. Intrathecal fentanyl added to hyperbaric ropivacaine for urological surgery. Eur J Anaesthesiol. 2004;21(Suppl 32):122. https://journals.lww.com/ejanaesthesiology/fulltext/2004/06002/intrathecal_fentanyl_added_to_hyperbaric.444.aspx
10. Am S. Ropivacaine - fentanyl an alternative to bupivacaine - fentanyl for major lower limb and lower abdominal surgeries - A comparative study. J Anesth Intensive Care Med 2019;8. https://doi.org/10.19080/jaicm.2019.08.555736.
11. Layek A, Maitra S, Gozi NK, Bhattacharjee S, Pal S, Sen S, et al. Comparison between intrathecal isobaric ropivacaine-fentanyl and bupivacaine-fentanyl in elective infraumbilical orthopedic surgery: A randomized controlled study. J Anaesthesiol Clin Pharmacol 2015;31:542–6. https://doi.org/10.4103/0970-9185.169086.
12. Varun S, Srivastava M, Maurya I, Garg R, Dhama V, Manik YK. A clinical prospective, randomized study to compare intrathecal isobaric bupivacaine–fentanyl and isobaric ropivacaine–fentanyl for lower abdominal and lower limb surgeries. Anaesth Pain Intensive Care. 2012;16(3):237–42. Available from: https://applications.emro.who.int/imemrf/Anaesth_Pain_Intensive_Care/Anaesth_Pain_Intensive_Care_2012_16_3_237_242.pdf
13. Rathod S, Das C, Jain T. Comparison of anesthetic and analgesic effect of isobaric 0.5% ropivacaine versus levobupivacaine with fentanyl as adjuvant in lower limb surgeries under spinal anesthesia a randomized double-blind, interventional study. J Appl Pharm Res. 2023;11(1):15–9. https://doi.org/10.18231/j.joapr.2023.11.1.15.19
14. Singh A, Shivpriya, Sharma S, Gupta A. Comparison of effectiveness of ropivacaine (0.5 %) with fentanyl, and bupivacaine (0.5 %) with fentanyl, in spinal anaesthesia in lower limb and lower abdominal surgeries. J Evid Based Med Healthc 2020;7:2836–40. https://www.jebmh.com/articles/comparison-of-effectiveness-of-ropivacaine-05--with-fentanyland-bupivacaine-05--with-fentanyl-in-spinal-anaesthesia-in-l.pdf.pdf
15. Jivanbhai D, Patel. To compare the efficacy of intrathecal 0.75% heavy ropivacaine and 0.5% heavy bupivacaine for lower abdominal and lower limb surgery. Asian J Med Sci. 2023;14(9):58–63. https://doi.org/10.3126/ajms.v14i9.53793
16. Wang H-Z, Chen H-W, Fan Y-T, Jing Y-L, Song X-R, She Y-J. Relationship between body mass index and spread of spinal anesthsia in pregnant women: A randomized controlled trial. Med Sci Monit 2018;24:6144–50. https://doi.org/10.12659/MSM.909476.
17. Sujatha C, Sundararajan C, Asokan A. Comparative evaluation of anesthetic efficacy and hemodynamic effects of intrathecal isobaric bupivacaine versus intrathecal isobaric levobupivacaine in the lower abdominal and lower limb surgeries. Asian J Med Sci 2022;13:57–62. https://doi.org/10.3126/ajms.v13i9.46975.
18. Bakshi RG, Jadhav MS, Dhande K, Malliwal A, Raghu K, Langade D. A prospective randomized double-blind study to compare the efficacy of intrathecal 0.5% hyperbaric bupivacaine and intrathecal 0.75% hyperbaric ropivacaine in lower abdominal and lower limb surgeries. Int J Sci Res. 2023:7–10. https://doi.org/10.36106/ijsr/940573719
19. Vyas V, Adhikari P, Naseem S, Shelke U. Comparative efficacy and safety of intrathecal ropivacaine versus intrathecal bupivacaine in patients undergoing lower abdominal surgical procedures. Ind J Pain 2020;34:43. https://doi.org/10.4103/ijpn.ijpn_54_18.
20. Nath A, Banu P, Choudhury DB, Biswas A, Naser SM. Analgesic effect of intrathecal nalbuphine in comparison with fentanyl as an adjuvant with hyperbaric bupivacaine (0.5%) during spinal anaesthesia in lower abdominal surgery: a double-blinded randomised clinical study. J Clin Diagn Res. 2022. https://doi.org/10.7860/jcdr/2022/58698.16961
21. Shah AA, Islam MU, Ahmad I, Islam A, Gillani SaS, Farooq MA, et al. Intrathecal fentanyl with small-dose bupivacaine: stable hemodynamics in geriatric population undergoing orthopedic surgery. Pak Biomed J. 2022;5(4):239–43. https://doi.org/10.54393/pbmj.v5i4.381
22. Surana RN, Jain T. Evaluation of adjunctive analgesia with intrathecal fentanyl along with hyperbaric bupivacaine in spinal anesthesia for elective cesarean section. Int J Res Med Sci 2020;8:2924. https://doi.org/10.18203/2320-6012.ijrms20203439.
23. Vampugalla P, Vundi V, Kumar K, Kambar C, Mahalakshmi P, Pisipati R. A comparative study of intrathecal ropivacaine with fentanyl and L-bupivacaine with fentanyl in lower abdominal and lower limb surgeries. Int J Basic Clin Pharmacol 2015:1147–55. https://doi.org/10.18203/2319-2003.ijbcp20151349.

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