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Original Research Paper

Anaesthesiology

COMPARATIVE EVALUATION OF INTRATHECAL ADMINISTRATION OF BUPRENORPHINE OR FENTANYL AS AN ADJUVANT TO LEVOBUPIVACAINE (HYPERBARIC) IN PATIENTS UNDERGOING LOWER ABDOMINAL SURGERIES

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ABSTRACT

Background: Using intrathecal adjuvants in spinal anesthesia aims to enhance analgesic efficacy and prolong the duration of sensory and motor blocks. Buprenorphine and fentanyl are commonly used adjuvants with distinct pharmacological profiles, offering varying benefits in terms of onset time and duration of analgesia. This study seeks to evaluate and compare the effectiveness and safety of these two adjuvants when combined with hyperbaric levobupivacaine in patients undergoing lower limb surgeries. **Aims And Objectives:** The study compared the efficacy and safety of intrathecal buprenorphine and fentanyl as adjuvants to hyperbaric levobupivacaine in patients undergoing lower limb surgeries. **Materials And Methods:** An analytical cross-sectional study was conducted at Sri Aurobindo Medical College and Post Graduate Institute, Indore, from 1st September 2022 to 1st February 2024. Eighty-four patients, aged 18 to 40 years with ASA grade 1 and 2 status, scheduled for lower limb surgeries under subarachnoid block were enrolled. Patients were randomly assigned to two groups: Group B (n=42) received intrathecal levobupivacaine 0.5% with 30 mcg buprenorphine, and Group F (n=42) received intrathecal levobupivacaine 0.5% with 25 mcg fentanyl. Sensory and motor block characteristics, intraoperative hemodynamic parameters, duration of postoperative analgesia, and adverse effects were assessed. **Results:** The demographic characteristics were comparable between the groups. The onset time of sensory block was significantly faster in Group F (2.7 ± 0.6 minutes) compared to Group B (3.8 ± 1.3 minutes, $p < 0.001$). Conversely, the onset of motor block was quicker in Group B (7.7 ± 2.7 minutes) compared to Group F (10.2 ± 2.9 minutes, $p < 0.001$). Intraoperative hemodynamic parameters were similar between the groups. The duration of adequate postoperative analgesia was significantly longer in Group B (422.2 ± 10.28 minutes) compared to Group F (288.6 ± 4.30 minutes, $p < 0.001$). Group B required fewer additional analgesic doses within the first 24 hours postoperatively (mean 1.2 doses) compared to Group F (mean 2.1 doses, $p < 0.001$). Adverse effects were comparable between the groups, with no significant differences. **Conclusion:** Both buprenorphine and fentanyl are effective and safe adjuvants to levobupivacaine for intrathecal anesthesia in lower limb surgeries. Buprenorphine offers a significantly longer duration of postoperative analgesia, while fentanyl provides a faster onset of sensory block.

KEYWORDS : intrathecal anesthesia, buprenorphine, fentanyl, levobupivacaine, lower limb surgeries

INTRODUCTION

The management of postoperative pain is a critical component of patient care, particularly in lower abdominal surgeries. [1] Effective pain control enhances patient comfort, facilitates early mobilization, reduces hospital stay, and minimizes the risk of chronic pain development.[1] Regional anesthesia, particularly spinal anesthesia, is a commonly employed technique that offers several advantages over general anesthesia, including reduced systemic side effects and superior analgesia.[2,3]

Levobupivacaine, the S-enantiomer of bupivacaine, is a long-acting local anesthetic widely used in spinal anesthesia due to its favorable pharmacokinetic and pharmacodynamic profile.[4] It provides effective sensory and motor blockade with a lower incidence of cardiotoxicity and neurotoxicity compared to bupivacaine. However, the duration of postoperative analgesia with levobupivacaine alone may be inadequate, necessitating the use of adjuvants to prolong its effects.[5]

Intrathecal adjuvants, such as opioids, have been extensively studied for their ability to enhance the quality and duration of spinal anesthesia. Buprenorphine and fentanyl are two opioids commonly used in this context. Buprenorphine, a partial agonist at the mu-opioid receptor, is known for its prolonged analgesic effect and ceiling effect on respiratory depression. [6,7] Fentanyl, a potent mu-opioid receptor agonist, provides rapid onset of analgesia with minimal hemodynamic alterations. Both agents have been shown to improve the quality of spinal anesthesia, but their comparative efficacy and safety when used with hyperbaric levobupivacaine in lower abdominal surgeries remain to be fully elucidated.[8,9]

This study aims to compare the efficacy and safety of intrathecal buprenorphine and fentanyl as adjuvants to hyperbaric levobupivacaine in patients undergoing lower abdominal surgeries. The primary outcome measures include the duration of analgesia, the quality of intraoperative and postoperative analgesia, and the incidence of adverse effects. This research seeks to inform clinical practice and optimize pain management strategies for patients undergoing lower abdominal surgeries by elucidating these adjuvants' comparative benefits and drawbacks.

MATERIALS AND METHODS

Study Design and Setting

This analytical cross-sectional study was conducted at the Sri Aurobindo Medical College and Post Graduate Institute, Indore (M.P.), from 1st September 2022 to 1st February 2024.

Sample Size and Participants

The study included a sample size of 84 patients who were scheduled for lower limb surgeries under subarachnoid block. Eligible participants were patients receiving subarachnoid block for lower limb surgeries, with ASA (American Society of Anesthesiologists) grade 1 and 2 status, and aged between 18 and 40 years. Patients who did not consent had known allergies to any of the drugs used, had infections at the local site, or had anatomical abnormalities of the spine were excluded from the study.

Grouping and Interventions

The patients were divided into two groups of 42 each. Group B received intrathecal levobupivacaine 0.5% with 30 mcg buprenorphine, while Group F received intrathecal levobupivacaine 0.5% with 25 mcg fentanyl. Before the procedure, patients were kept nil by mouth for eight hours, and an intravenous line was secured. All patients were preloaded with 500 ml of Ringer's lactate solution. Baseline values of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR), and oxygen

saturation (SPO2) were obtained before premedication.

Anesthesia Procedure

In the operation theatre, patients were positioned in the sitting position and, under aseptic conditions, a subarachnoid block was administered by injecting 0.5% hyperbaric levobupivacaine 3 ml with either 30 mcg buprenorphine or 25 mcg fentanyl through a 25-gauge spinal needle at the L3-L4 or L4-L5 interspace. Following the injection, each patient was immediately placed in the supine position. Sensory block levels were assessed every minute after the subarachnoid block using perception to cold, while motor block levels were evaluated using the modified Bromage scale. The time at the end of the injection was recorded and considered as time zero for subsequent data recording.

Monitoring And Definitions

SBP, DBP, MAP, and HR were measured at 1, 3, 5, 10, 30, and 60-minute intervals. Hypotension was defined as a drop in SBP greater than 20% of the baseline value or an SBP less than 100 mmHg. Bradycardia was described as a greater than 30% drop from baseline HR or when the HR dropped below 50 beats per minute.

Statistical Analysis

The collected data were systematically recorded and analyzed using appropriate statistical methods. Continuous variables such as SBP, DBP, MAP, HR, and duration of analgesia were expressed as mean ± standard deviation (SD) and compared using the independent t-test. Categorical variables, such as the incidence of hypotension and bradycardia, were presented as frequencies and percentages and analyzed using the chi-square test or Fisher's exact test, as appropriate. The level of statistical significance was set at $p < 0.05$. All statistical analyses were performed using SPSS software (version 26.0, IBM Corp., Armonk, NY, USA). Graphical representations were used to illustrate key findings, and confidence intervals (CIs) were calculated to assess the precision of the estimated effects.

RESULTS

Demographic Data

A total of 84 patients were enrolled in this study:

42 in Group B (intrathecal levobupivacaine 0.5% with 30 mcg buprenorphine) and 42 in Group F (intrathecal levobupivacaine 0.5% with 25 mcg fentanyl). The demographic characteristics, including age, weight, and gender distribution, were comparable between the two groups, with no statistically significant differences ($p > 0.05$).

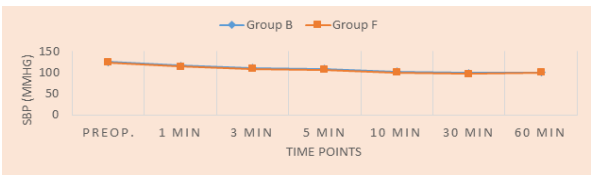

Figure 1: Changes in SBP between groups

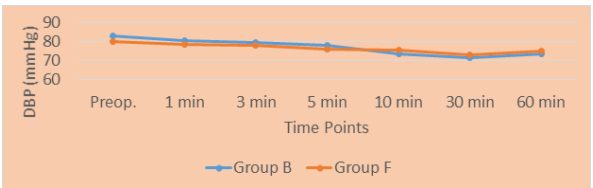

Figure 2: Changes in DBP between groups

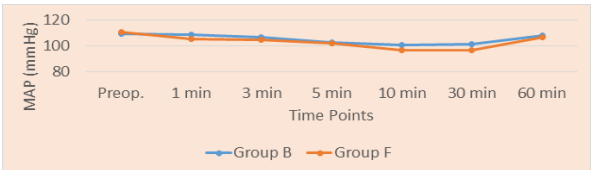

Figure 3: Changes in MAP between groups

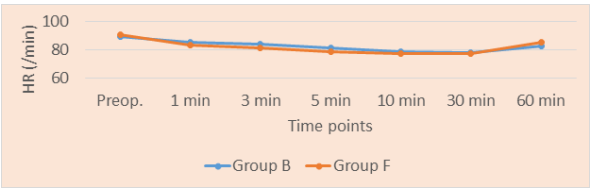

Figure 4: Changes in HR between groups

Sensory And Motor Block Characteristics

The onset time of the sensory block, as assessed by the perception of cold, was significantly faster in Group F than in Group B, showing an onset time of 3.8 ± 1.3 minutes and Group F showing an onset time of 2.7 ± 0.6 minutes ($p<0.001$) (table 1). However, the onset of motor blockade (in minutes) evaluated using the modified Bromage scale was significantly quicker in Group B (7.7±2.7) than in Group F (10.2±2.9) with a p-value of <0.001(table 1).

Table 1: Comparing sensory and motor parameters between groups

Parameters	Group B	Group F	P value
Onset of sensory block (in minutes)	3.8±1.3	2.7±0.6	<0.001
The onset of motor blockade (in minutes)	7.7±2.7	10.2±2.9	<0.001
Duration of analgesia (in minutes)	422.2±10.28	288.6±4.30	<0.001

Intraoperative Hemodynamic Changes

Intraoperative hemodynamic parameters were recorded at specified intervals, including SBP, DBP, MAP, and HR. These values were similar between the two groups, indicating a well-matched baseline hemodynamic status ($p > 0.05$) (Figures 1-4).

Postoperative Analgesia

The duration of adequate postoperative analgesia, defined as the time from the end of the block to the first request for additional analgesia, was significantly longer in Group B (**422.2±10.28** minutes) compared to Group F (**288.6±4.30** minutes) ($p < 0.001$) (table 1). The total number of additional analgesic doses required within the first 24 hours postoperatively was lower in Group B (mean 1.2 doses) compared to Group F (mean 2.1 doses) ($p < 0.001$).

Adverse Effects

The incidence of adverse effects, including nausea, vomiting, pruritus, and respiratory depression, was recorded. Nausea and vomiting were more commonly reported in Group B (n=4) compared to Group F (4=3). None of the patients in either group reported pruritus, hypotension, or sedation. Two patients in Group F reported bradycardia, and three patients had inadequate analgesia.

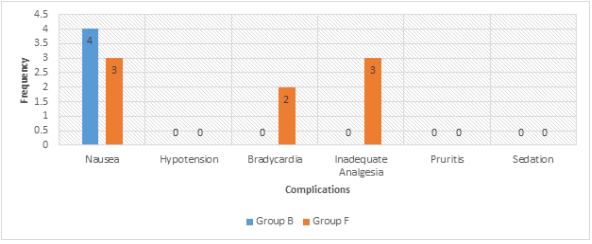

Figure 5: Incidence of complication between groups

DISCUSSION

This study aimed to compare the efficacy and safety of intrathecal buprenorphine and fentanyl as adjuvants to levobupivacaine in patients undergoing lower limb surgeries. Our findings revealed significant differences in the onset and

duration of sensory and motor blocks and the duration of postoperative analgesia between the two groups.

Sensory and Motor Block Characteristics

Our study demonstrated that the onset of sensory block was significantly faster in the fentanyl group (2.7 ± 0.6 minutes) compared to the buprenorphine group (3.8 ± 1.3 minutes, $p < 0.001$). This finding aligns with previous studies, such as those by Techanivate et al. (2004), who reported an early onset of sensory block with the addition of fentanyl to hyperbaric bupivacaine.[10] On the other hand, the onset of motor block was quicker in the buprenorphine group (7.7 ± 2.7 minutes) compared to the fentanyl group (10.2 ± 2.9 minutes, $p < 0.001$).[10] This discrepancy highlights the differential effects of these adjuvants on sensory and motor block dynamics.

Intraoperative Hemodynamic Changes

Intraoperative hemodynamic parameters, including SBP, DBP, MAP, and HR, were similar between the two groups, indicating that both buprenorphine and fentanyl, when used as adjuvants, maintain stable hemodynamic profiles. These findings are consistent with previous studies that have reported comparable hemodynamic stability with these adjuvants.[11,12]

Postoperative Analgesia

One of the most notable findings of our study was the significantly longer duration of adequate postoperative analgesia in the buprenorphine group (422.2 ± 10.28 minutes) compared to the fentanyl group (288.6 ± 4.30 minutes, $p < 0.001$). This extended duration of analgesia with buprenorphine resulted in fewer additional analgesic doses required within the first 24 hours postoperatively (mean 1.2 doses) compared to the fentanyl group (mean 2.1 doses, $p < 0.001$). These results are in line with the findings of Khan et al. [12], who reported prolonged analgesia with intrathecal buprenorphine compared to fentanyl.

Adverse Effects

The incidence of adverse effects, including nausea, vomiting, pruritus, and respiratory depression, was low and comparable between the groups. Nausea and vomiting were slightly more common in the buprenorphine group (n=4) compared to the fentanyl group (n=3), but this difference was not statistically significant. No cases of pruritus, hypotension, or sedation were reported in either group. Two patients in the fentanyl group experienced bradycardia, and three patients had inadequate analgesia. These findings suggest that both adjuvants are relatively safe, with a low incidence of adverse effects, consistent with previous research.[11,13]

Comparison With Previous Studies

Our study's results align with the findings of several previous studies but also highlight some differences. For instance, Singh et al. [14] found that intrathecal fentanyl did not alter the onset of sensory or motor block. In contrast, our study found a faster onset of sensory block with fentanyl. Additionally, while Khan et al. [12] reported no significant difference in the onset of the sensory block between fentanyl and buprenorphine, our study demonstrated a faster sensory onset with fentanyl and a faster motor onset with buprenorphine. These discrepancies may be attributed to differences in study design, patient populations, and dosages used.

Clinical Implications

The findings of this study have important clinical implications. The significantly longer duration of postoperative analgesia with buprenorphine makes it a preferable adjuvant for procedures requiring extended pain relief. However, the faster onset of sensory block with fentanyl may be advantageous in situations where a rapid onset of anesthesia is desired. Therefore, the choice of adjuvant should be tailored to the specific clinical scenario, balancing the need for rapid onset versus prolonged analgesia.

Limitations And Future Research

This study has limitations, including the relatively small sample size and the short follow-up period. Future research should focus on larger, multicenter trials with longer follow-ups to validate these findings. Additionally, studies exploring the optimal dosing and combinations of these adjuvants could provide more nuanced insights into their use in clinical practice.

CONCLUSION

Both buprenorphine and fentanyl are effective and safe adjuvants to levobupivacaine for intrathecal anesthesia in lower limb surgeries. Buprenorphine provides longer postoperative analgesia, while fentanyl offers a quicker onset of sensory block. These findings can help anesthesiologists select the appropriate adjuvant based on the specific needs of their patients.

REFERENCES

1. Horn R, Hendrix JM, Kramer J. Postoperative Pain Control. [Updated 2024 Jan 30]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK544298/
2. Jain Y, Lanjewar R, Lamture Y, Bawiskar D. Evaluation of Different Approaches for Pain Management in Postoperative General Surgery Patients: A Comprehensive Review. Cureus. 2023 Nov 9;15(11):e48573. doi: 10.7759/cureus.48573. PMID: 38073977; PMCID: PMC10710279.
3. C Small, H Laycock, Acute postoperative pain management, British Journal of Surgery, Volume 107, Issue 2, January 2020, Pages e70–e80, https://doi.org/10.1002/bjs.11477
4. Bajwa SJ, Kaur J. Clinical profile of levobupivacaine in regional anesthesia: A systematic review. J Anaesthesiol Clin Pharmacol. 2013 Oct;29(4):530-9. doi: 10.4103/0970-9185.119172. PMID: 24249993; PMCID: PMC3819850.
5. Burlacu CL, Buggy DJ. Update on local anesthetics: focus on levobupivacaine. Ther Clin Risk Manag. 2008 Apr;4(2):381-92. doi: 10.2147/tcrm.s1433. PMID: 18728849; PMCID: PMC2504073.
6. Rabiee SM, Alijanpour E, Jabbari A, Rostami S. Benefits of using intrathecal buprenorphine. Caspian J Intern Med. 2014 Summer;5(3):143-7. PMID: 25202441; PMCID: PMC4143735.
7. Gupta R, Verma R, Bogra J, Kohli M, Raman R, Kushwaha JK. A Comparative study of intrathecal dexmedetomidine and fentanyl as adjuvants to Bupivacaine. J Anaesthesiol Clin Pharmacol. 2011 Jul;27(3):339-43. doi: 10.4103/0970-9185.83678. PMID: 21897504; PMCID: PMC3161458.
8. Nayak A, Ninave S, Tayade S, Tayade H. Intrathecal Adjuvant Midazolam Versus Fentanyl With Hyperbaric Bupivacaine for Post-operative Analgesia in Women Undergoing Total Abdominal Hysterectomy. Cureus. 2023 Jun 17;15(6):e40565. doi: 10.7759/cureus.40565. PMID: 37465806; PMCID: PMC10351601.
9. Gupta R, Verma R, Bogra J, Kohli M, Raman R, Kushwaha JK. A Comparative study of intrathecal dexmedetomidine and fentanyl as adjuvants to Bupivacaine. J Anaesthesiol Clin Pharmacol. 2011 Jul;27(3):339-43. doi: 10.4103/0970-9185.83678. PMID: 21897504; PMCID: PMC3161458.
10. Techanivate A, Urusopone P, Kiatgungwanglia P, Kosawiboonpol R. Intrathecal fentanyl in spinal anesthesia for appendectomy. J Med Assoc Thai. 2004;87:525–30.
11. Khanna MS, Singh Ikwinder KJP. Comparative evaluation of bupivacaine plain versus bupivacaine with fentanyl in spinal anaesthesia in geriatric patients. Ind J Anaesth. 2002;46:199–203.
12. Khan FA, Hamdani GA. Comparison of intrathecal fentanyl and buprenorphine in urological surgery. J Pak Med Assoc. 2006;56:277–81.
13. Singh, Arvinder Pal; Kaur, Ravinder; Gupta, Ruchi; Kumari, Anita. Intrathecal buprenorphine versus fentanyl as adjuvant to 0.75% ropivacaine in lower limb surgeries. Journal of Anaesthesiology Clinical Pharmacology 32(2):p 229-233, Apr–Jun 2016.
14. Singh H, Jang J, Thornoton K. Intrathecal fentanyl prolongs sensory bupivacaine spinal block. Canad J Anaesth. 1995;42:987–91.