ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 05 | May - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A STUDY TO COMPARE THE EFFICACY OF INTRATHECAL FENTANYL AND BUPRENORPHINE AS ADJUVANTS TO BUPIVACAINE IN GYNAECOLOGICAL SURGERY.

Anaesthesiology

Dr. Arjya Bhatta Hazarika PGT, Department of Anaesthesiology, AMCH, Dibrugarh

Dr Karuna Kumar Das Professor and Head, Department of Anaesthesiology, AMCH, Dibrugarh

ABSTRACT

Background and Objective: Hyperbaric bupivacaine is widely utilized for spinal anesthesia, either on its own or in combination with various adjuvant drugs. Among these, opioids are commonly chosen due to their quick onset and strong analgesic effects. Fentanyl is a favoured intrathecal opioid because of its rapid action, though its effects are relatively short-lived. Buprenorphine, a partial agonist-antagonist, binds strongly to both mu(μ) and kappa(κ) opioid receptors. In this study, we compared the use of buprenorphine and fentanyl as intrathecal adjuvants to hyperbaric bupivacaine in patients undergoing gynaecological surgeries. **Methodology:** Following approval from the Institutional Ethical Committee and after obtaining written informed consent, 60 patients aged between 18 and 65 years scheduled for lower abdominal gynaecological surgery were randomly assigned into two equal groups. Group F received 2.5 ml of 0.5% hyperbaric bupivacaine combined with 25 μg of intrathecal fentanyl, while Group B received the same dose of bupivacaine with 75 μg of intrathecal buprenorphine. The characteristics of the block and any side effects were evaluated and compared between the groups. Data analysis was performed using the Chi-square test and Fisher's exact test, while the independent Student's t-test was applied for comparing means between the two groups. A p-value of less than 0.05 was considered statistically significant. **Results:** The mean onset of sensory and motor block was significantly earlier in Group F than Group B ($p < 0.001$). Mean duration of sensory block was significantly prolonged in Group B compared to Group F ($p < 0.05$). Whereas, the duration of motor was comparable in both of the groups ($p > 0.05$). **Conclusion:** Group F exhibited a quicker onset of sensory and motor blockades, whereas Group B was associated with a prolonged sensory block. The duration of motor block was similar in both groups.

KEYWORDS

Spinal anaesthesia, Bupivacaine, Fentanyl, Buprenorphine.

INTRODUCTION

Spinal anaesthesia is the most commonly used technique for lower abdominal and lower limb surgeries including gynaecological surgeries.[1] Hyperbaric bupivacaine is one of the most commonly used local anaesthetic due to its rapid onset and reliable block characteristics.[2,3] To enhance the quality and duration of the block, various adjuvants, including opioids, are added to the local anaesthetic.[4] Fentanyl and Buprenorphine are two such opioids that have been studied for their effects when combined with hyperbaric Bupivacaine in spinal anaesthesia.

Intrathecal opioids, such as fentanyl and buprenorphine, are frequently utilized as adjuncts to local anaesthetics in spinal anaesthesia. These opioids enhance the sensory blockade without significantly affecting sympathetic pathways, thereby achieving effective spinal anaesthesia with reduced doses of local anaesthetics.

Fentanyl is a potent, centrally acting opioid that is commonly combined with local anaesthetics for perioperative anaesthesia and analgesia. It primarily binds to the mu(μ) opioid receptors in the central nervous system, contributing to its analgesic effects.

Buprenorphine, on the other hand, is a mixed agonist-antagonist opioid with a high affinity for both mu(μ) and kappa(κ) opioid receptors. It acts as a weak antagonist at κ receptors and a partial agonist at μ receptors. Buprenorphine is often preferred in peripheral settings due to its availability compared to fentanyl.

Both fentanyl and buprenorphine, when used in combination with local anaesthetics, can enhance the quality and duration of spinal anesthesia while minimizing the required dose of local anaesthetics.

We compared the effects of intrathecal administration of fentanyl and buprenorphine with hyperbaric bupivacaine, on block characteristics in elective gynaecological surgeries.

AIMS AND OBJECTIVES

Aim

To compare the efficacy of intrathecal fentanyl and buprenorphine as adjuvants to bupivacaine in elective gynaecological surgeries.

Objectives

- To compare the time of onset of sensory and motor blocks when fentanyl or buprenorphine was used intrathecally as adjuvants to bupivacaine in elective gynaecological surgeries.
- To compare the duration of sensory and motor blocks when fentanyl or buprenorphine was used intrathecally as adjuvants to bupivacaine in elective gynaecological surgeries.

MATERIALS AND METHODS

Place of Study

The present study was carried out at Assam Medical College and Hospital, Dibrugarh.

Type of Study

Hospital based observational study.

Sample Size and Statistical Analysis

For two mean $n = 2S2(Z1-\alpha/2+Z1-\beta)2 /2$. Where, S = pooled standard deviation, n = required number of samples for each group, 1-β = power, 1-α = level of confidence, d = mean difference, S = combined standard deviation, α = 5% level of significance at two tailed test, 80% is the power of the study with one-to-one ratio. Sample size required for each group was calculated to be 30 (n = 30).

Statistical analysis was performed using statistical package for the social sciences (SPSS), Version 23.0. IBM Corp., NY). Simple descriptive statistics were used, e.g., mean ± SD for quantitative variables, and frequency with percentage for categorized variables. The data was analyzed using Chi square test and Fisher's exact test. For comparing two groups of means independent student's t test was used. P-value < 0.05 was considered as statistically significant.

Ethical Clearance

Ethical clearance was taken from the Institutional Ethics Committee(H) of the institute before the study commenced.

Consent

Written and informed consent is taken from all patients.

Inclusion and Exclusion Criteria

Following approval from the Institutional Ethics Committee(H) and obtaining written informed consent, a total of 60 patients (30 in each group) aged between 18 and 65 years, classified as American Society of Anesthesiologists (ASA) grade I or II, were enrolled in this observational study. These patients were scheduled for elective lower abdominal gynaecological surgeries.

Exclusion criteria encompassed individuals who do not give consent.

Patients with a history of coagulopathy or on anticoagulants, morbid obesity, known hypersensitivity to the drugs under investigation, or those requiring emergency surgical intervention.

Methodology

A detailed history was taken and a detailed physical examination was carried out for all patients preoperatively. After shifting the patients to the operation theatre, continuous monitoring of electrocardiogram, noninvasive blood pressure and pulse oximetry was carried out. Intravenous line was secured with an 18 G cannula in the dorsum of the hand and connected to IV fluids. Patient was premedicated with Inj. Ondensetron. Vasopressors ephedrine, phenylephrine were kept ready. After explaining the procedure and securing written informed consent, a midline lumbar puncture was performed on patients in the sitting position at the L3–L4 intervertebral space using a 25-gauge Quincke spinal needle. The procedure was conducted under strict aseptic conditions. Upon confirming the free flow of cerebrospinal fluid through the spinal needle, the study drug solution was administered, and the patients were then repositioned to a supine posture.

All patients were assigned to one of the two equal groups by consecutive sampling method; Group F received 0.5% hyperbaric bupivacaine 2.5 ml with fentanyl 25 µg; and Group B received 0.5% hyperbaric bupivacaine 2.5 ml with buprenorphine 75 µg. Total volume of the drugs administered intrathecally was 3 ml in both the groups.

Duration of sensory-motor block was measured from the point of commencement of spinal anaesthesia. The upper level of sensory block was assessed bilaterally by pinprick method. Modified Bromage scale was used to assess motor block; 0 = Patient able to move hip, knee, ankle, 1 = Unable to move hip, able to move knee and ankle, 2 = Unable to move hip and knee, able to move ankle, 3 = Unable to move hip, knee and ankle. Assessment of block was performed every 2 min after the spinal anaesthesia till the T6 dermatomal level and Bromage score of 3 was achieved. After that it was performed at every 20 min, until the recovery of S2 dermatome (duration of the sensory block) and Bromage score of 0 (duration of the motor block) was achieved. Haemodynamic variables were monitored continuously and any incidence of associated side-effects was documented till sensory-motor levels regressed to above-mentioned threshold during the postoperative period.

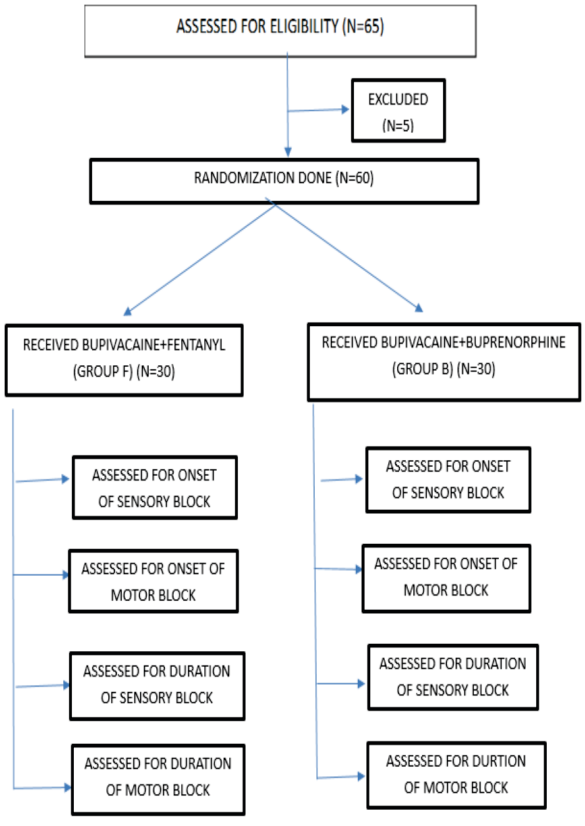

Fig 1. Consort Flow Diagram

Table 1. Demographic Parameters of Patient Studied. (n=30)

Parameters	Group F	Group B	P value
Age(y)	41.23±3.82	40.82±7.35	0.786
Weight(kg)	64.32±7.72	61.82±3.88	0.116
Height(m)	159.77±2.22	160.64±4.63	0.356
ASA status I/II	20/10	21/09	0.781

Data presented as mean ± SD or numbers. $p < 0.05$ considered as significant.

Table 2. Comparison of Onset and Duration of Sensory and Motor Block Between the Two Groups. (n=30)

Parameters	Group F	Group B	P value
Onset of sensory block (min)	2.74±0.36	3.33±0.44	<0.001
Onset of motor block (min)	3.63±0.34	4.01±0.36	<0.001
Duration of sensory block (min)	235.59±4.00	272.08±4.75	<0.001
Duration of motor block (min)	191.38±7.32	188.56±5.49	0.094

Data presented as mean ± SD or numbers. $p < 0.05$ considered as significant, SD = Standard deviation.

Table 3. Comparison of Side Effects and Complications Between the Two Study Groups. (n=30)

Complications	Group F	Group B
Nausea	6	9
Hypotension	0	0
Bradycardia	2	0
Pruritus	0	0
Shivering	2	8

Data is presented as number.

RESULTS

In this study, Table 1 shows that age, height, weight, ASA grading were comparable in each group.

The mean time of onset of sensory block was significantly earlier in Group F (2.74±0.36 min) than Group B (3.33±0.44 min) ($p < 0.001$) (Table 2). Whereas, the mean duration of sensory block was significantly prolonged in Group B (272.08±4.75 min) compared to Group F (235.59±4.00min). (Table 2).

The mean time for onset of motor block was significantly earlier in Group F (3.63±0.34 min) when compared with Group B (4.01± 0.36 min) ($p < 0.001$) (Table 2). Whereas, the duration of motor block (Modified Bromage score to become 0) was comparable in both the groups ($P > 0.05$). (Table 2)

On comparing the side effects, nausea was seen in 6 (20%) of participants in Group F as compared to 9 (30%) in Group B. Bradycardia was seen in 2 (6.66%) cases in Group F while it was not seen in Group B. Shivering was experienced by 8 (26.66%) participants in Group B as compared to 2 (6.66%) in Group F. Hypotension and pruritus not seen in either group.

DISCUSSION

In this study, we compared two opioids—fentanyl and buprenorphine—as adjuvants to local anaesthetics in spinal anaesthesia. Fentanyl is a pure µ-opioid receptor agonist, whereas buprenorphine is a partial agonist with high lipid solubility. Our findings align with previous research by Khan et al[5], which reported that fentanyl provided a faster onset of both sensory and motor blocks compared to buprenorphine. This rapid onset is likely due to fentanyl's higher lipid solubility resulting in faster elimination from the cerebral fluid and a quick initial therapeutic effect.[6]

Regarding the duration of sensory block, our study observed a significantly longer duration in the buprenorphine group (Group B) compared to the fentanyl group (Group F), with a p-value of < 0.001. This prolonged effect is attributed to buprenorphine's higher affinity for the µ-opioid receptor and slow dissociation kinetics and its sustained action at the receptor site resulting in persistent complexes.[7] In contrast, fentanyl, another highly lipophilic opioid, has a shorter duration of action. Despite its high lipid solubility, fentanyl is rapidly cleared from spinal cord sites, leading to a shorter-lived analgesic effect. These results are consistent with Khan et al's study, which also found that buprenorphine extended the duration of sensory blockade.

However, the duration of motor block was comparable between the

two groups, indicating that both opioids had similar effects on motor blockade. This finding is also in agreement with Khan et al[5], who reported no significant difference in the duration of motor block between fentanyl and buprenorphine.

In summary, while fentanyl offers a quicker onset of sensory and motor blocks, buprenorphine provides a longer duration of sensory block without affecting the motor block duration. These characteristics should be considered when selecting an opioid adjuvant for spinal anaesthesia, depending on the clinical requirements of the procedure.

The hemodynamic parameters such as pulse rate, mean systolic blood pressure (SBP), mean diastolic blood pressure (DBP) and mean arterial pressure (MAP) were not statistically significant at different time intervals intraoperatively and postoperatively ($p>0.05$).

When comparing side effects, nausea occurred in 6 participants (20%) in Group F and in 9 participants (30%) in Group B. Bradycardia was reported in 2 cases (6.66%) in Group F but was absent in Group B. Shivering was noted in 8 participants (26.66%) from Group B, while only 2 participants (6.66%) in Group F experienced it. Neither hypotension nor pruritus was observed in either group.

CONCLUSION

In conclusion, the data indicates that Group F achieved a faster onset of both sensory and motor blocks, while Group B provided a longer duration of sensory block. Both groups demonstrated comparable durations of motor block. These findings suggest that the choice between the two techniques should be tailored to the specific clinical requirements, balancing the need for rapid onset with the desired duration of sensory and motor blockade

LIMITATIONS

While the study provides valuable insights, certain limitations should be considered:

Sample Size: The sample size of 30 per group may limit the generalizability of the findings. Larger studies could provide more robust data.

Single-Center Study: Conducting the study at a single center may introduce biases related to institutional practices and patient populations.

Lack of Long-Term Follow-Up: The study focuses on immediate outcomes, and long-term effects of the interventions were not assessed.

REFERENCES

1. Di Cianni S, Rossi M, Casati A, Cocco C, Fanelli G. Spinal anesthesia: an evergreen technique. Acta Biomed. 2008 Apr;79(1):9-17. PMID: 18551816.
2. Uppal V, Retter S, Shanthanna H, Prabhakar C, McKeen DM. Hyperbaric Versus Isobaric Bupivacaine for Spinal Anesthesia: Systematic Review and Meta-analysis for Adult Patients Undergoing Noncesarean Delivery Surgery. Anesth Analg. 2017 Nov;125(5):1627-1637. PMID: 28708665.
3. Pargger H, Hampl KF, Aeschbach A, Paganoni R, Schneider MC. Combined effect of patient variables on sensory level after spinal 0.5% plain bupivacaine. Acta Anaesthesiol Scand. 1998 Apr;42(4):430-4. doi: 10.1111/j.1399-6576.1998.tb05137.x. PMID: 9563862.
4. Swain A, Nag DS, Sahu S, Samaddar DP. Adjuvants to local anesthetics: Current understanding and future trends. World J Clin Cases. 2017 Aug 16;5(8):307-323. doi: 10.12998/wjcc.v5.i8.307. PMID: 28868303; PMCID: PMC5561500.
5. Khan FA, Hamdani GA. Comparison of intrathecal fentanyl and buprenorphine in urological surgery. J Pak Med Assoc. 2006 Jun;56(6):277-81. Erratum in: J Pak Med Assoc. 2006 Oct;56(10):482. Dosage error in published abstract; MEDLINE/PubMed abstract corrected. PMID: 16827252.
6. Bhatia J, Suryawanshi C. Comparative Analysis of Intrathecal Bupivacaine With Fentanyl Versus Intrathecal Bupivacaine With Midazolam in Lower Abdominal and Lower Limb Surgeries. Cureus. 2024 Sep 7;16(9):e68908. doi: 10.7759/cureus.68908. PMID: 39381493; PMCID: PMC11459076.
7. Kumar R, Viswanath O, Saadabadi A. Buprenorphine. 2024 Jun 8. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 29083570.