

A COMPARATIVE STUDY OF BUPIVACAINE AND BUPIVACAINE WITH FENTANYL FOR SUBARACHANOID BLOCK

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**ABSTRACT****Introduction:** Subarachnoid block (SAB) is the anesthesia of choice for lower abdominal and lower limb surgeries. The objective of the study was to evaluate and compare the onset, duration, recovery of neural blockade, hemodynamic changes and side effects of bupivacaine alone with fentanyl added to bupivacaine.**Materials and methods:** This cross sectional comparative study was conducted in Department of Anaesthesia at National Medical College in 82 patients from April 2023 to September 2023. Patients of either sex as per American Society of Anaesthesiologists, Physical Status I-II between age 20-60 years were randomly allocated to one of two groups of 41 each.**Results:** This study showed that there was highly significant difference in the highest level of sensory block achieved between the two groups ($p < 0.001$) and motor blockade. Most of patients receiving bupivacaine alone (Group B) had achieved T6 dermatomal sensory level block and Bromage score of 4, while patients receiving fentanyl with bupivacaine (Group F) achieved T8 and also Bromage score of 3 respectively. The mean duration for highest sensory level in group F and group B was 7.76 and 9.66 minutes, respectively. The mean duration for 2 segment regression in group F and group B was 95.28 and 67.24 minutes respectively. Hypotension was significantly high in Group B.**Conclusion:** Fentanyl added to bupivacaine has an earlier onset of action, prolonged sensory analgesia but earlier motor recovery compared to bupivacaine alone but a comparatively lower sensory dermatomal level without complete motor blockade, adequate for surgical procedures.**Keywords:** Bupivacaine, Fentanyl, Spinal Anaesthesia**INTRODUCTION**

Spinal anesthesia is a safe, convenient and economical form of regional anesthesia technique. It results in sympathetic blockade, sensory analgesia, and motor blockade depending on the dose, concentration or volume of local anesthetic agent administered. Bupivacaine is the most common local anesthetic agent used. The desired effect is to block the transmission of nerve signals to and from the affected area.¹

The increasing acceptance of subarachnoid block can be attributed to the simplicity of the technique and equipment, economy, maintenance of consciousness and spontaneous respiration, muscle relaxation, minimal disturbances of body chemistry, less intra operative bleeding, decreased incidence of post-operative nausea, vomiting and aspiration, prolonged post-operative analgesia and a pleasant recovery from anaesthesia.²

However, these advantages are oppressed by limited duration of action of subarachnoid block and by uncomfortable postoperative period when its action

wears off. In order to prolong the duration of analgesia, using a higher dosage of local anesthetic agent can lead to undesirable hemodynamic disturbances such as hypotension and bradycardia as a result of a high block.³

Hence, various adjuvants have been added to intrathecal bupivacaine and they include; adrenaline, clonidine, ketamine, phenylephrine, midazolam, neostigmine and opioids such as morphine and fentanyl.⁴

In view of the above, this study was undertaken to evaluate the effects of hyperbaric bupivacaine in combination with fentanyl for subarachnoid block for lower abdominal, urological and lower extremity surgeries which are to be completed in less than two hours.

MATERIALS AND METHODS

It was a cross sectional comparative study conducted in Department of Anaesthesia at National Medical College, Birgunj between April 1, 2023 to September 30, 2023.

Ethical approval from the Institutional Review Committee was obtained before enrolment in this study. The ethical approval number was F-NMC/623/079-080. Written informed consent was obtained from the patients.

All patients of either sex between age of 18-65 years, American Society of Anaesthesiologists (ASA) I-II, undergoing elective surgery that was completed in less than 2 hours were included in this study. Patients whose age was less than 18 or greater than 65 years, ASA III-V, surgeries lasting more than 2 hours, emergency surgeries, with history of bleeding disorder, on anticoagulant therapy, deformities of spinal cord, mental disturbance or neurological disease, hypersensitivity to local anesthetics, local infection at the site of proposed for puncture for spinal anesthesia and who did not give written informed consent were excluded from this study.

Study population was divided into 2 groups and sample size was calculated by formula $[2\sigma^2/(m_1 - m_2)^2] \times f(\alpha, \beta)$. σ is standard deviation, m_1 is mean of time of onset of sensory block in bupivacaine, m_2 mean of time of onset of sensory block in bupivacaine plus fentanyl. Through the article⁵ $f(\alpha, \beta) = 10.5$ (from the table). Taking $\sigma = 0.43$, $m_1 = 1.10$, $m_2 = 0.79$, $f(\alpha, \beta) = 10.5$ calculated sample size was 41 in each group. Convenient Sampling method was used. Patients in Group B received 15mg of hyperbaric Bupivacaine (3ml) and group F received 12.5mg of hyperbaric bupivacaine plus 25µg fentanyl (3ml).

Study variables like age, sex, height, ASA, systolic and diastolic blood pressure, heart rate, level of sensory block, level of motor block, duration of 2 segment regression, Modified Bromage scale, adverse effect of the drugs were calculated.

Patients after an overnight fast and drug therapy for concomitant medical problems was continued as deemed appropriate. In the operating theatre before lumbar puncture, preloading was done with 500ml of crystalloid. All patients were monitored with non-invasive automated blood pressure, pulse oximetry and ECG. Baseline blood pressure, heart rate and mean arterial pressure was recorded.

Under aseptic precautions, with patient in lateral position or sitting position 3ml of the drug was given at L2-L3 space by a midline approach with a 25G Quincke Babcock needle after confirming free flow of CSF and then the patients were placed in supine position.

Systolic and diastolic blood pressure, heart rate and mean arterial pressure was recorded at 3 minutes interval for first 30 minutes. After this initial observation period, measurement of heart rate, systolic and diastolic blood pressure and mean arterial blood pressure was made for every 15 minutes till the end of procedure.

Sensory blockade testing of dermatomal level was done using pinprick method at midclavicular line. Level of pinprick analgesia was performed at 3 minutes interval for first 30 minutes and then at 15 minutes interval at the end of operation, 2 hours from the injection and thereafter at 30 minutes interval until the sensory blockade completely recovered and noted.

Motor blockade was tested in the lower limbs and graded using modified Bromage score.

Testing was performed at 3 minutes interval for first 30 minutes and then 15 minutes interval until the end of operation, 2 hours from the injection and thereafter at 30 minutes interval until the motor blockade completely recovered and noted. Side effects to be assessed for nausea, vomiting, bradycardia and hypotension.

Statistical analysis was done using students unpaired "t" test (comparison) and students "t" test, Chi square and ANOVA test for qualitative data.

RESULTS

Eighty two patients were included in this study with 41 in each group.

The mean age and height in group B was 43.98 ± 13.47 years and 165.41 ± 5.15 cm and in group F was 43.27 ± 14.93 years and 164.05 ± 4.99 cm.

Table 1. Demographics and clinical characteristics of study population

PARAMETERS		Group	
		B (n,%)	F (n,%)
SEX	Male	28, 68.3	25, 61
	Female	13, 31.7	16, 39
ASA	1	27, 65.9	28, 68.3
	2	14, 34.1	13, 31.7
MODIFIED BROMAGE SCORE	3	0	13, 31.7
	4	41, 100	28, 68.3

ASA: American Society of Anaesthesiologists

Table 2: Outcome of patients that were included in this study.

Characteristics	Group		P value
	B(n=41)	F (n=41)	
Duration of motor block (Mean \pm SD)	161.95 \pm 3.80	139.85 \pm 4.56	<0.001
Time to maximum dermatomal sensory level (Mean \pm SD)	9.66 \pm 1.957	7.76 \pm 1.64	<0.001

SD: Standard Deviation

Table 3: Highest level of sensory block

Highest dermatomal sensory level	Group		Total (100%)	P value
	B (n=41)	F (n=41)		
T6 n(%)	26(63.4)	7(17.1)	33(40.2)	<0.001
T8 n(%)	11(26.8)	22(53.7)	33(40.2)	
T10 n(%)	4(9.8)	12(29.3)	16(19.5)	
Total n(%)	41(100)	41(100)	82(100)	

Table 4 : Complications observed

	Group		P value
	B (n=41)	F (n=41)	
Nausea			
Absent n(%)	37(90.2)	41(100)	0.116
Present n(%)	4(9.8)	0(0.0)	
Vomiting			
Absent n(%)	39(95.1)	41(100)	0.494
Present n(%)	2(4.9)	0(0.0)	
Hypotension			
Absent n(%)	30(73.2)	41(100)	0.00
Present n(%)	11(26.8)	0(0.0)	
Bradycardia			
Absent n(%)	40(97.6)	38(92.7)	0.616
Present n(%)	1(2.4)	3(7.3)	

DISCUSSION

Spinal anaesthesia is the anaesthesia of choice for lower abdominal and lower limb surgeries as it is simple to perform and economical, produces rapid onset of anaesthesia, analgesia with good muscle relaxation, causes better suppression of neuroendocrine stress response.

Bupivacaine is the most popular local anaesthetic drug for subarachnoid blockade because of less neurotoxicity. However, intrathecal bupivacaine alone may be insufficient to provide prolonged post-operative analgesia, even with high sensory block. Since the discovery of opioid receptors in the brain and spinal cord, the use of intrathecal opioids has become common practice as an effective method of analgesia⁶

Fentanyl, a lipophilic opioid, after intrathecal administration diffuses into epidural space and subsequently into the plasma, suggesting that it acts not only through spinal opioid receptors but also systemically.

Fentanyl added to bupivacaine intrathecally provides better surgical anaesthesia and increased reliability of block than intrathecal bupivacaine alone⁷

Motor block duration:

In our study, duration of motor block was prolonged in group B (161.95±3.8 min) as compared to group F (139.85±4.56 min) and was statistically significant. This implies that patients in group F receiving bupivacaine and fentanyl recovered earlier from motor block.

This was similar to the study conducted by Mehta S, Dalwadi H and Shad T et al⁸ where duration of motor block was prolonged in control group (162.5±7.5min) as compared to study group (129.4±9.9min).

In another study conducted by Al Akam TA, Hussein EM et al⁹ duration of motor block was prolonged in control group (162±7 min) compared to study group (129±9 min) and was statistically significant and consistent to our study.

Modified Bromage score:

Our study showed that all of the patients in Group B had complete motor blockade with Modified Bromage score of 4, but 13 patients out of 41 in Group F could still flex their toes suggesting a Modified Bromage score of 3.

Kararmaz, A., Kaya, S., Turhanoglu et al¹⁰ in 2003 found in their study a significantly less profound motor block after administering intrathecal bupivacaine along with fentanyl, which is similar to our study.

Time to reach maximum sensory level:

In our study, mean time to reach maximum sensory level was observed to be (9.66 ±1.95) minutes for Group B and (7.76±1.64) minutes for Group F which is statistically significant. This shows that the mean time to reach maximum sensory level was earlier in bupivacaine plus fentanyl group.

Indurkar P, Saibaba et al¹ found that mean time to reach maximum sensory level was (22.50 ± 3.40) minutes for control group and (17.93 ± 2.62) minutes for study group. This result was consistent to our study.

Similarly, Jayshree Prajapati and Hiren Parmar¹¹ noted that the mean time to reach maximum sensory level was less in fentanyl group (3.57±0.93) minutes as compared to control group (5.8±1.03) minutes.

2 Segment regression time:

Time to two sensory segment regression in group B was 67.24 ± 3.19 min compared to 85.32 ± 4.23 min in Group

F. Duration of action of intrathecal heavy bupivacaine 0.5% is 90-200 minutes whereas duration of action of intrathecal fentanyl is 4-6 hours. This explains the considerably longer duration of analgesia in the study group when compared to using bupivacaine alone.

Our study result was similar to the study done by Uike S, Choudhary S et al¹² and Indurkar P, Saibaba et al¹ and Ben-David, B., Solomon, E et al¹³.

The duration of two segment regression of sensory blockade was prolonged in Group F than in Group B, which concurs with the study made by Venkata HG, Pasupuleti S, Pabba UG et al¹⁴.

Highest level of sensory block:

In our study highest level of sensory block was observed to be T6 in Group B and T8 in Group F. This implies that intrathecal bupivacaine plus fentanyl has a lower level of sensory block in comparison to intrathecal bupivacaine alone.

Girgin, N. K., Gurbet A et al¹⁵ in 2008 observed in their study, the highest sensory blockade levels achieved were T7 (range T5 – T9) and T6 (range T4 – T9) in groups Levobupivacaine plus Fentanyl and Levobupivacaine only, respectively.

Nausea:

In our study four patients of Group B had nausea, whereas there were no patients complaining of nausea in Group F.

Venkata, H. G., Pasupuleti, S et al¹⁴ observed no patients complained of nausea and vomiting may be due to reduction of dose of bupivacaine from 10 mg to 7.5 mg causing less hypotension which was consistent with our finding.

Regmi BD, Deo GP, Shrestha S et al¹⁶ found that nausea and vomiting were found in 6(16.2%) in fentanyl and bupivacaine group and 10 (27.01%) in conventional bupivacaine group which was consistent with our study.

Vomiting:

Nausea and vomiting during spinal anesthesia may be related to a postural hypotension and hypoxemia of the vomiting center.

In our study 2 patients of Group B had vomiting, whereas there were no patients in Group F who had vomiting. It was observed that there was not much difference in both the groups which was consistent with the findings of study done by Kararmaz, A., Kaya, S., Turhanoglu et al¹⁰ and Hussien RM, Rabie AH¹⁷.

Hypotension:

Incidence of hypotension as well as fall in the systolic BP increases with the dose of bupivacaine.

Kararmaz A, Kaya S et al¹⁰ did a study on low-dose bupivacaine-fentanyl spinal anaesthesia for transurethral prostatectomy and concluded that intrathecal bupivacaine combined with fentanyl provides adequate anaesthesia for TURP in elderly patients and was associated with a lower incidence of hypotension than a conventional dose of bupivacaine. Our findings are also consistent with this study.

Bradycardia:

Bradycardia results from the blockade of sympathetic cardio accelerator fibers and decreased venous return to the heart¹⁸.

In our study 1 patient from Group B and 3 patients from Group F had bradycardia of which only 1 patient from Group F needed medication Inj. Atropine 0.12mg. There was not much differences between the two group.

Prabha P et al¹⁹ in their study found combination of bupivacaine with fentanyl maintains stable intraoperative haemodynamic parameters and decreases the incidence of adverse effects like bradycardia, which was similar to our study.

CONCLUSION

Addition of 25 µg fentanyl to 0.5 % heavy bupivacaine for spinal anaesthesia augments the onset of sensory and motor block, produces better quality of sensory block with time for 2 segment regression reduced thus prolonging the duration of analgesia, reduces the duration of motor blockade, reduces the dose of bupivacaine required thus decreasing the incidence of hypotension.

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