

COMPARISON AMONG INTRATHECAL FENTANYL AND BUTORPHANOL AS AN ADJUVANT TO HYPERBARIC BUPIVACAINE FOR LOWER LIMB ORTHOPAEDIC PROCEDURES

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ABSTRACT

AIMS & OBJECTIVES

The study was conducted to compare the effect of

- Bupivacaine Heavy 0.5% 3 ml with fentanyl (25 mcg) 0.5 ml.
- Bupivacaine Heavy 0.5% 3 ml with Butorphanol (25 mcg) 0.5 ml

When administered intrathecally for lower limb orthopedic procedures.

MATERIAL AND METHODS

After obtaining a written and informed consent a comparative study of 60 patients. Patients were randomly divided in two groups of 30 each. Group BB (Butorphanol group) received 25 mcg Butorphanol with 15 mg hyperbaric Bupivacaine (0.5%; 3.0 ml) Group BF (Fentanyl Group) received 25 mcg fentanyl with 15 mg hyperbaric Bupivacaine (0.5%, 3.0 ml).

BACKGROUND

- Amongst the drugs used for spinal anesthesia Bupivacaine is still considered as the standard drug. Combining opioids with local anesthetics has got a synergistic effect, improving intra & postoperative analgesia. Combination of these agents reduces side effects caused by either of them.
- We therefore conducted this study to evaluate the efficacy of Butorphanol & Fentanyl as adjuvant to Bupivacaine in lower limb orthopedic surgeries.

OBSERVATION AND RESULTS

- When Fentanyl and Butorphanol are used as an adjuvant to hyperbaric Bupivacaine for spinal anesthesia, Butorphanol provides longer duration of sensory & motor block compared to Fentanyl.
- Duration of analgesia was also longer with Butorphanol which delayed the time for 1st analgesic request compared to fentanyl.
- No significant haemodynamic changes or adverse effects were noted with either adjuvant.

CONCLUSION

Though Butorphanol intrathecally did not enhance the degree of sensory or motor block, its prolonged duration of Bupivacaine induced sensory block & reduced analgesic requirement during early post op period, with good hemodynamic stability without any adverse effects.

KEYWORDS-

INTRATHECAL BUPIVACAINE HEAVY, FENTANYL, BUTORPHANOL, SPINAL ANAESTHESIA

Introduction: -

Cocainisation of the spinal cord was described by August Bier in 1899¹. Among the local anesthetic agents used, Bupivacaine is still considered standard drug for subarachnoid block. Pain is an unpleasant sensory and emotional experience associated with potential tissue damage. By adding a small dose of narcotics to local anesthetic solution, the duration of anesthesia and analgesia (intra and post-operative) can be significantly prolonged⁸. A combination of these agents reduces the side effects caused by either of them due to decrease in dose required to achieve the desirable effects especially in geriatric patients^{2,5}. Both the opioids chosen, Fentanyl and Butorphanol belong to Phenanthrene group of agonist-antagonists, having agonist action on kappa receptor and antagonist or partial agonist property at mu receptor. Butorphanol is widely available without

restriction as compared to Fentanyl and other potent opioids. We therefore conducted this study to evaluate the efficacy of Butorphanol and Fentanyl as adjuvant to Bupivacaine in orthopedic surgeries.

Aim of Study: -

Present study was conducted to compare the effect of

- Bupivacaine 0.5% 3.0 ml with Fentanyl (25mcg) 0.5 ml
 - Bupivacaine 0.5% 3.0 ml with Butorphanol (25mcg) 0.5 ml
- when administered intrathecally for lower limb procedures.

Methods and Materials: -

We carried out this observational study on 60 patients of ASA grade I & II, between 18-60 yrs. of age, of either sex undergoing elective surgery for lower limb orthopedic procedures.

Patient exclusion criteria:

- Patient refusal
- Patient with gross spinal deformity, peripheral neuropathy, local infection
- 1. Known allergy to local anesthetics
- 2. Coagulation disorder
- 3. Surgeries due to last longer than 3 hrs.
- 4. ASA grade III, IV, V

Group BF: (N=30) Bupivacaine-Fentanyl group patients received 15 mg Bupivacaine heavy (0.5%) (3ml) with 25mcg Fentanyl (0.5ml).

Group BB: (N=30) Bupivacaine-Butorphanol group patients received 15 mg Bupivacaine heavy (0.5%) (3ml) with 25 mcg Butorphanol (0.5ml) (from 1mg/ml ampoule).0.5 mg (0.5 ml) Butorphanol was diluted up to 10 ml with normal saline to

make 50 mcg/ml.0.5 ml of this solution was taken with 3.0 ml Bupivacaine to make total volume 3.5 ml.

All patients received total volume 3.5 ml intrathecally.

Anaesthetic protocol:

- *Preoperative preparation:* -After thorough pre-operative evaluation, informed written consent was obtained from each patient All patients were fasted overnight and Baseline values of vital parameters were noted. A peripheral venous access was secured on non-dominant hand with 18-gauge cannula and preloading was done with lactated Ringers solution 8-10 ml/kg in within 20-30 min prior to subarachnoid block.

Anesthesia Technique: -Under strict aseptic and antiseptic precautions, subarachnoid block was performed in sitting position, between L₃-L₄ intervertebral space, with 25G spinal needle (Quincke's) via midline approach. After free flow of CSF, the test drug was injected over 10-15 secs. Patients were made in supine position after completion of block. The surgical anesthesia was considered adequate when sensory block up to T₁₀ dermatome and motor block of Bromage grade III was achieved. Intraoperatively HR, SBP, DBP, MAP, RR and SpO₂ were recorded every 2 mins for first 15 mins, then every 15 mins for 2 hours, every 30 mins for 4 hrs., every 6 hrs. till 24 hrs. in postoperative ward. At the end of procedure patients were shifted to postoperative ward where monitoring was continued.

Observations were made considering following points:

Haemodynamic stability: HR, SBP, DBP, MAP

Respiratory parameters: RR, SpO₂

Onset of sensory and motor block

-Time for highest sensory block and dermatomal level achieved

-Time for motor block to reach modified Bromage grade 3

-Time for 2 segment regression of sensory level

-Time for motor block to regress to Bromage grade 1

-Time for sensory regression to S₁ level

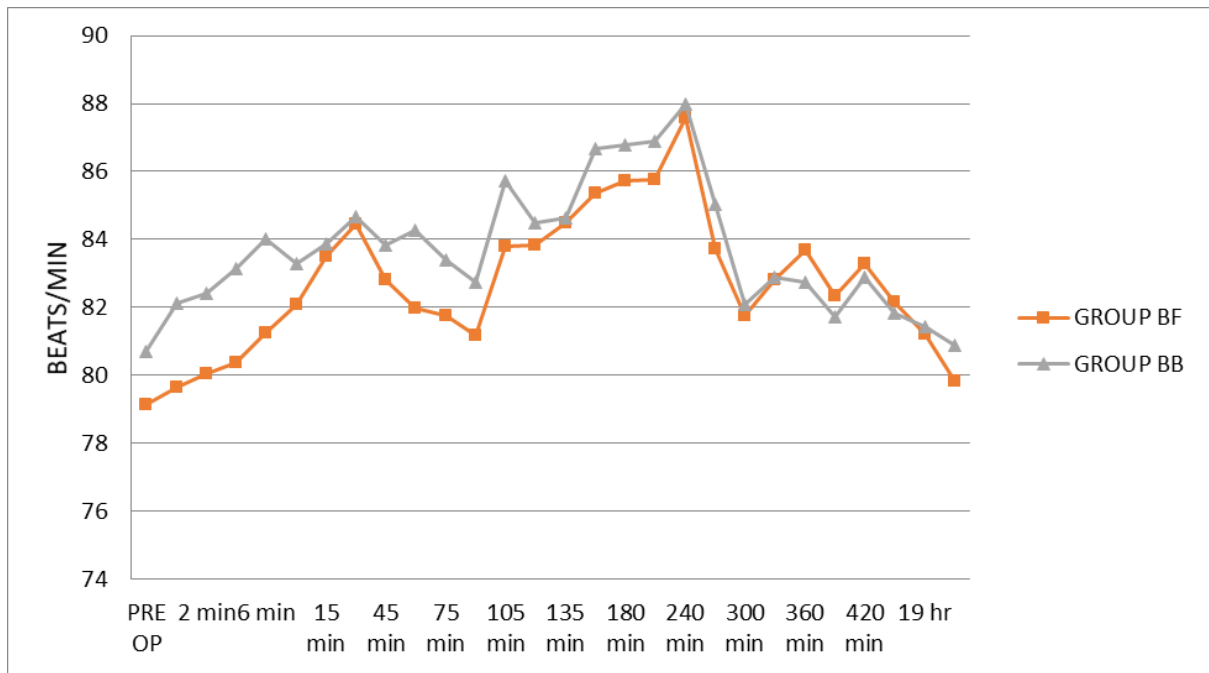
-Time for 1st analgesic demand post operatively or when VAS score was ≥ 5 whichever was first.

The data were studied using mean values and SD and then compared using unpaired 't' test. P value of <0.05 was considered significant.

Observation and Results: -

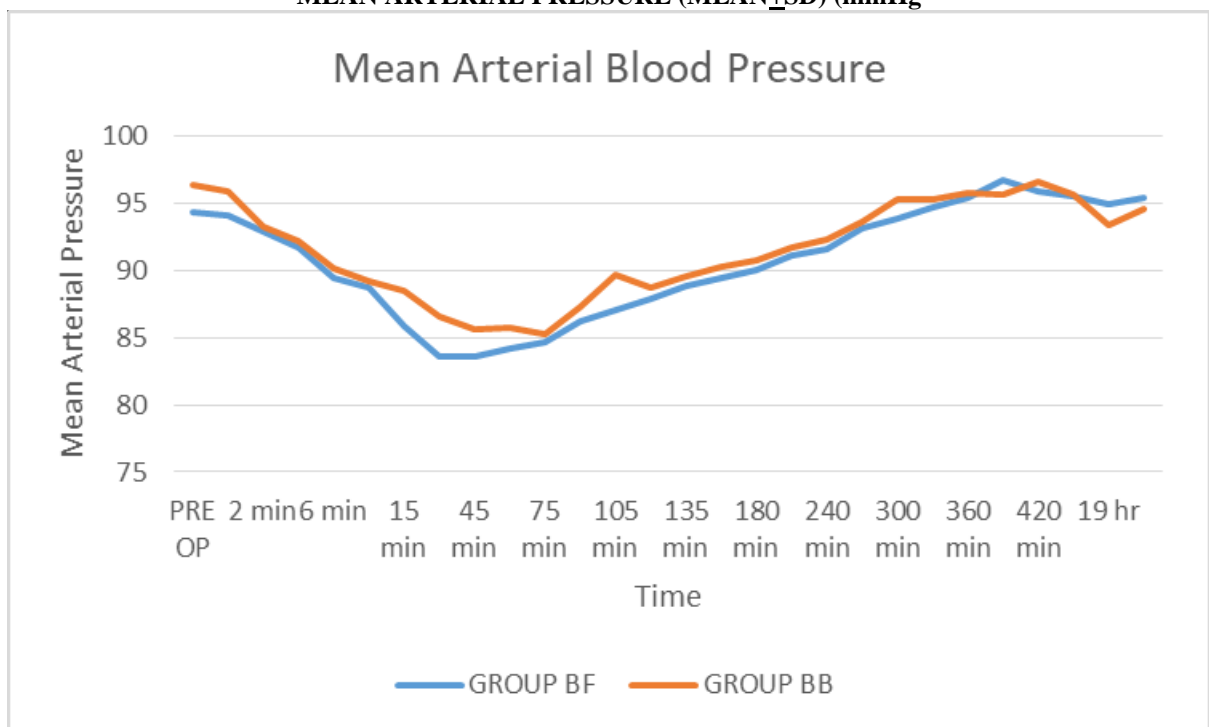
Observation and results are summarized and described below. Both groups comprised of 30 patients.

GRAPH 1
CHANGES IN HEART RATE (/MIN) (MEAN \pm SD)



The base line heart rate was comparable in both the groups. No significant change in heart rate was observed in Group BB and Group BF during intra op and post op periods.

GRAPH 2
MEAN ARTERIAL PRESSURE (MEAN+SD) (mmHg)



Base line Systolic blood pressure, Diastolic blood pressure and Mean arterial pressure were comparable in both the groups. No statistically significant difference was seen in blood pressure monitoring in both the groups.

TABLE 1
CHARACTERISTICS OF SENSORY AND MOTOR BLOCK (MEAN+SD)

PARAMETER	GROUP BF	GROUP BB	P VALUE BF vs BB	INFERENCE
ONSET OF SENSORY BLOCK (SEC)-T1	23.10+2.76	24.20+2.01	0.08	NS

ONSET OF MOTOR BLOCK (SEC)-T2	36.10+4.96	37.00+4.75	0.48	NS
TIME FOR PEAK SENSORY BLOCK (MINS)-T3	5.42+0.63	5.57+0.50	0.31	NS
TIME FOR PEAK MOTOR BLOCK -T4 (BROMAGE G-3) (MINS)	6.05+0.78	6.03+0.60	0.93	NS
TIME FOR 2 SEGMENTS SENSORY REGRESSION (MINS) -T5	123.60+7.20	151.73+7.86	8.29 * 10 ⁻²¹	S
TIME FOR MOTOR REGRESSION (BROMAGE G-1) (MINS) -T6	172.77+8.16	193.47+9.80	2.64 *10 ⁻¹²	S
TIME FOR SENSORY REGRESSION TO S1 (MINS) -T7	187.33+7.07	215.13+11.15	1.41 *10 ⁻¹⁵	S
TIME FOR RESCUE ANALGESIA (MINS) -T8	231.77+10.93	281.90+10.73	2.50 *10 ⁻²⁵	S

Mean duration of sensory and motor block was statistically significant and Motor block (**193.47±9.80 mins**) and sensory block (**215.13±11.15 mins**) was longer in Group BB than Group BF. Mean time for requirement of rescue analgesia was observed to be significantly longer in Group BB (**281.90±10.73 mins**) as compared to Group BF (**231.77±10.93 mins**).

TABLE 2
VAS SCORE

TIME	GROUP BF	GROUP BB	P VALUE	INFERENCE
180 min	0.70+0.60	0.50+0.50	0.10	NS
210 min	1.70+0.70	1.20+0.48	0.002	S
240 min	2.27+0.64	1.77+0.50	0.001	S
270 min	5.17+1.56	4.07+0.69	0.001	S
300 min	4.47+1.72	5.6+0.67	0.001	S
330 min	2.90+1.16	2.73+1.08	0.50	NS
360 min	2.50+0.97	2.40+0.57	0.51	NS
390 min	2.20+0.71	2.13+0.51	0.68	NS
420 min	3.27+0.71	3.00+0.69	0.07	NS
13 hr.	3.77+0.94	3.47+0.78	0.18	NS
19 hr.	5.03+0.96	4.83+1.15	0.47	NS
24 hr.	4.30+1.26	4.20+1.21	0.76	NS

As shown from the above table, mean time for VAS score ≥ 5 in group BF was around 270 min where as in group BB it was around 300 min. In VAS score observation during 210 min to 300 min significant difference was observed between both the groups.

COMPLICATIONS:

Bradycardia, hypotension, shivering, nausea, vomiting, pruritis, sedation, urinary retention, respiratory depression

Discussion: -

Spinal anesthesia has become the choice of anesthesia for lower limb surgical procedures since many decades. Bupivacaine is the most commonly used local anesthetic in spinal anesthesia. Intrathecal adjuvants (intrathecal opioids) were used to lower the dose of Bupivacaine as they provided adequate and prolong perioperative analgesia with improved hemodynamic stability, but allow early ambulation of patients because of their sympathetic and motor nerve sparing activities.

Local anesthetics such as Bupivacaine act mainly by blockade of voltage gated Na⁺ channels in the axonal membrane and presynaptic inhibition of calcium channels. Both Butorphanol and Fentanyl exert their action by opening K⁺ channels and reducing the Ca⁺⁺ influx, resulting in inhibition of transmitter release. A combination of these effects may explain the observed synergism between Bupivacaine and Butorphanol/Fentanyl. The synergism is characterized by enhanced somatic analgesia without an effect on the degree of level of local anesthetic induced sympathetic or motor blockade.

Demographic data:

In terms of age, weight, height and ASA grade, both the groups were comparable in our study. **Binaykumar et.al**,2011³, used Butorphanol-Bupivacaine mixture in lower limb orthopedic surgeries and stated that the wide variability in the age of the patients (18-75yrs) in their study was a confounding factor in relation to perception of pain as pain perception varies with age. However, this was not observed in our study as the demographic data (age:18-55yrs) did not have extreme variability and was comparable to other studies.

Drug and Dose:

We chose the doses of 25µg Butorphanol (0.5 ml) and 25 µg of Fentanyl (0.5 ml), as this dose provided better post-operative analgesia with significantly lower side effects. Volume of Bupivacaine heavy (0.5%) was 3.0 ml in all cases in our study. **Binaykumar et.al**,2011³, and **Vinita et.al**,2006⁷, used similar concentration of Butorphanol and Fentanyl with 2.5 ml Bupivacaine heavy. **Manpreet et. Al**,⁴studied addition of butorphanol 25 mcg & sufentanil 10mcg to 1.5 ml Bupivacaine for subarachnoid block in urological surgery.

Onset, Peak Sensory and motor blockade:

In our study, Time for onset of sensory block in Group BB (24.2±2.01sec) and Group BF (23.1±2.76 sec), Time to achieve highest sensory level (T10) in Group BB (5.57±0.50 min) and in Group BF (5.42±0.63 min) were nearly equal. There was no significant difference in onset of motor blockade in both the groups (Group BB 37.0±4.75 sec and Group BF 36.1±4.94 sec) and time to achieve Bromage Grade 3 motor block (Group BB 6.03±0.60 min and Group BF 6.05±0.78 min). **Binaykumar et. Al**³observed time from injection to highest sensory block (T8) to be (8.0±1.7) min and (8.6±1.4) min with Fentanyl and Butorphanol groups respectively. Their time to achieve Bromage grade 3 motor blocks was (9.5±1.8) min and (10.1±1.7) min in Fentanyl and Butorphanol group respectively.

Duration of sensory and motor block:

In our study, duration of sensory and motor block was longer with Butorphanol, (215.13±11.15 min and 193.47±9.80 min) as compared to that of Fentanyl (187.33±7.07 min and 172.77±8.16 min). **Binaykumar et.al**, 2011,³observed total duration of sensory block to be 156±18.4 min and 167.0±23.8 min in Fentanyl and butorphanol group **respectively**. **Manpreet et. al**,⁴duration of both sensory block and motor block was lower 170.87±22.21 min and 132.20 ± 20.8 min respectively in group butorphanol in their study. Though results were significant, both the durations are lower as compared to our study. This could be attributed to lower dose of Bupivacaine in their study.

Duration of analgesia: In our study, Butorphanol with Bupivacaine not only provided adequate anesthesia & analgesia but also significantly prolonged its duration which was observed to be longer in Group Butorphanol (**281.90±1.73 min**) than Group Fentanyl (**231.77±10.93 min**).**Binaykumar et.al**.³ observed that patients receiving Butorphanol had lower VAS pain scores at all observed times than patients who received fentanyl, although this difference in VAS scores reached a statistical significance at 3 hours after spinal anesthesia given. A higher number of patients in the fentanyl group requested for rescue analgesia earlier than patients in the butorphanol group which correlated with our observation.

Similarly, **N. Gopal Reddy et.al**,⁶also observed that the duration of analgesia was more prolonged with intrathecal butorphanol than fentanyl, which were 272.8±17.2 min and 270±27.4 min respectively, which is comparable with our study.

Haemodynamic parameters & side effects/complications: In our study all the hemodynamic parameters of both the groups were comparable at all the time intervals.

Hypotension:

Two patients (6.67%) had hypotension in Group BF and In Group BB One patient (3.33%) had hypotension. **Binaykumar et.al**,³observed hypotension in two patients (5%) in the Butorphanol group and seven patients (17.5%) in Fentanyl group.

Bradycardia:

None of the patients had bradycardia in our study. **Binaykumar et.al**³, observed bradycardia in two patients (5%) with Fentanyl, which is insignificant when compared to Butorphanol.

Pruritus:

Pruritus which is related to cephalad migration of opioids in the CSF.In our study, two patients (6.67%) complained of pruritus in Fentanyl group. **Binaykumar et.al**,³observed pruritus in five patients (12.5%) in the Fentanyl group. **Vinita Singh et al**⁷ concluded that 25 mcg of fentanyl and butorphanol intrathecal have no difference regarding intraoperative itching or pruritus, post-operative nausea vomiting or psychomimetic behavior.

Sedation:

Vinita Singh et al⁷ observed 20% patients had sedation in butorphanol group, as compared to our study we observed that only 2 patients had Campbell sedation grade 2, but it wasn't statistically significant with fentanyl group. This finding is consistent with the previous studies by **B.N. Biswas et.al**, **Binay et.al**, **Prof.Dr. Subrata Nag et.al**, **N. Gopal Reddy et.al**

Conclusion: -

We conclude from our study that, when Fentanyl and Butorphanol are used as an adjuvant to hyperbaric Bupivacaine for spinal anesthesia, duration of sensory and motor block was longer with Butorphanol, (215.13+11.15 min and 193.47+9.80 min respectively) as compared to that of Fentanyl (187.33+7.07 min and 172.77+8.16 min respectively). Duration of analgesia was also longer with Butorphanol (281.90±1.73 min), which delayed the time for first analgesic request compared to Fentanyl (231.77±10.93 min). No significant haemodynamic changes or adverse effects were noted with either adjuvant.

In nutshell, Butorphanol is a good adjuvant to hyperbaric Bupivacaine for spinal anesthesia with good haemodynamic stability and longer analgesia without any adverse effects.

References: -

1. Bier A: Versuche uber Cocainisierung des Ruckenmarkes. Dtsch Z Chir 51:361- 369,1899.
2. Ben David B, Frankel R, Arzumov T, Marchevsky Y, Volpin G. Minidose Bupivacaine-Fentanyl Spinal Anaesthesia for Surgical Repair of Hip fracture of aged. Anesthesiology. 2000;92:6–10.
3. Kumar B, Williams A, Liddle D, Verghese M (2011) Comparison of intrathecal Bupivacaine-Fentanyl and Bupivacaine-Butorphanol mixtures for lower limb orthopedic procedures. Anesth Essays Res 5: 190-195.
4. Manpreet Kaur, Sunil Katyal, Suneet Kathuria, and Prabhjot Singh A comparative evaluation of intrathecal Bupivacaine alone, sufentanil or Butorphanol in combination with Bupivacaine for endoscopic urological surgery, Saudi J anaesth.2011 Apr-Jun; 5(2):202-207
5. McCral AF, Wildsmith JA. Prevention and treatment of hypotension during central neuraxial block. Br J. Anaesth. 1993;70: 672-80
6. N. Gopal Reddy, S. Manohar, P. Supriya, A. Himani.” Comparidon of Efficacy of Butorphanol and Fentanyl as Intrathecal Adjuvant to Bupivacaine”. Journal of Medical and Dental Sciences 2015; Vol 4, Issue 33, April 23; Page:5675-5681, DOI: 10.14260/jemds/2015/830.
7. Singh V, Gupta LK, Singh GP. Comparison among intrathecal Fentanyl and Butorphanol in combination with Bupivacaine for lower limb surgeries. J Anesth Clin Pharmacol 2006; 22:371-5
8. Sukhani R, Stevens RA. Spinal anesthesia in: Banzon HT, Raja SN, Borsook D, Mollory RE, Strichartz(eds). Essentials of pain medicine and regional anesthesia, Newyork; Churchill Livingston 1999; PP 350-7.

Conflict of Interest:

Nil

Funding:

Nil

Acknowledgement:

Nil