



**RESEARCH ARTICLE**

**Comparative Study between Effects of Bupivacaine and Bupivacaine with Fentanyl  
in Spinal Anesthesia on Hemodynamic Stability in Controlled Hypertensive Patients  
Posted for Orthopedic Surgeries**

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**ABSTRACT**

The study was designed to evaluate the effect of addition of fentanyl to intrathecal bupivacaine on hemodynamic stability in controlled hypertensive patients undergoing orthopedic surgery. Material and methods: sixty patients of either sex belonging to ASA Grade II and III undergoing elective orthopedic lower limb surgeries under spinal anesthesia were studied in this prospective, comparative, double blinded study. Patients were distributed randomly into two groups of 30 each. Group A received 3 ml (15mg) bupivacaine & group B received 2.5ml (12.5mg) bupivacaine with 25 µgm fentanyl. All patients were observed for onset and duration of sensory and motor block, duration of analgesia, changes of pulse rate, blood pressure, ST-T changes, ectopic beats and side effects. Results: onset of sensory and motor blockade was comparable in both the groups. Duration of sensory, motor block and analgesia were more in Group B than Group A. Patients were hemodynamically more stable in Group B than Group A. Hypotension and requirements of vasopressor less in Group B. Incidence of ST-T changes and ectopic beats were less in group B then Group A. Conclusion: it was concluded that use of intrathecal fentanyl 25µgm as adjuvants to bupivacaine 12.5mgm in controlled hypertensive patients can be a safer alternative with less side effects and provide good hemodynamic stability.

**KEYWORDS**

Fentanyl, Bupivacaine, Spinal Anaesthesia, Orthopedic Surgery, Hypertension

**INTRODUCTION**

Intrathecal opioids are synergistic with local anesthetics and intensify the sensory block without increasing the sympathetic block. As intrathecal morphine is associated with higher incidence of side effects.<sup>1</sup> Use of other opioids like fentanyl is combined with local anesthetics which have milder side effects. However side effects such as potentially catastrophic delayed respiratory depression have prompted further

research to develop non opioid analgesics with less worrisome side effects.<sup>2</sup>

Since the discovery of opioid receptors and the increase in spinal cord neuro pharmacological knowledge as to transmission and inhibition of nociceptive stimulations, there has been an increased interest in spinal adjuvant drugs for spinal anaesthesia and post operative pain relief.<sup>3,4</sup>

Studies have found that adding fentanyl intrathecally with bupivacaine decreases the requirement of total anesthetic dose, provides good intra operative quality of block without altering the degree of sympathetic blockade,

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ensures good hemodynamic stability, reduce the need for vasopressor drugs, and promote post operative analgesia.<sup>5-7</sup>

Hypertensive patients are more prone to hemodynamic changes like hypotension, bradycardia, transient ischemic changes and ectopic beats in spinal anesthesia with 0.5% bupivacaine.<sup>8</sup> The present study is designed with the primary aim evaluate “comparison between effects of inj. bupivacaine and inj. bupivacaine with fentanyl in spinal anesthesia on hemodynamic stability in hypertensive patients undergoing orthopedic surgery.

## **MATERIALS AND METHODS**

After approval from the institutional ethical committee, a written informed consent was obtained from patients. Sixty controlled hypertensive ASA grade II and III patients, in the age group of 40-70 years, with a long-standing history of hypertension of at least 5 years, scheduled for orthopedic surgery under spinal anesthesia were enrolled in this prospective, randomized, double blind study. The blood pressure of all patients was controlled with enalapril, amlodipine or combination of both drugs, to a systolic blood pressure of 140-150 mmHg and a diastolic blood pressure of 90-100 mmHg. Patients with history of neurological, neuromuscular, psychiatric, renal, hepatic diseases pregnancy or lactating women, drug abuse or alcoholism suspected coagulopathy, diabetic patients or known allergies, and those who had higher blood pressure preoperatively on the day of surgery were excluded from the study. Patients were randomly divided into two equal groups of 30 each. Randomization done with computer generated numbers.

Group A received bupivacaine and Group B received bupivacaine plus fentanyl. All the patients were thoroughly examined and investigated on the previous day of surgery. The patients were familiarized with the visual analogue score (VAS). It is a 10 cm scale in which “0” indicates no pain and “10” indicates worst imaginable pain. On the day of surgery all the patients were received routine anti hypertensive medication with sips of water. No

patients received any form of analgesic or sedative either preoperatively or intra operatively. Monitors such as ECG (electro cardiogram), SPO2 (oxygen saturation), NIBP (non invasive blood pressure) were attached. The vital data were recorded before giving spinal anesthesia. A wide bore intravenous line was secured; patients were preloaded with 10 ml/kg inj. Ringer lactate solution over period of 20 to 30 minutes before spinal anesthesia according to cardiac conditions. Patients were positioned in sitting position and after adequate aseptic precaution; lumbar puncture was performed with 25 G quincke needle at L3-L4 space. After ensuring a free flow of CSF, patients were received following drugs.

Group A: 0.5% 3ml bupivacaine heavy

Group B: 0.5% 2.5 ml bupivacaine heavy plus 25µgm. (0.5ml) inj fentanyl

The drug solutions were prepared by an anesthesiologist not involved in the study. The anesthesiologist performing the block and observing the patient was blinded to the treatment group. Data collection was done by the same anesthesiologist who was unaware of the group allocation.

After noting the time of injection patient was immediately placed in supine position. Operation table was kept in straight position. Patients were monitored for the following parameters. Both sensory and motor blocks were assessed every 5 minutes till their onset and at every 15 minutes till the end of surgery then hourly after completion of surgery until they were regressed. Patients were asked to note the subjective recovery of sensation and movements which was then certified by anesthesiologist. Onset of sensory block was defined as the time interval between injection and loss of pinprick sensation upto T10 level. Duration of sensory block was defined as time interval between the complete sensory block till regression up to S1 dermatome level.

Motor blockade was determined according to the Bromage scale. 0 – no paralysis, 1 – Inability to raise extended legs, 2 – Inability to flex the knee,

3 – Inability to flex ankle (complete motor block). Onset of motor block was defined as the time interval between total local anesthetic administration and motor block grade 1. Duration of motor block was defined as the time interval from onset of motor block bromage grade 3 to complete recovery of motor function of leg bromage grade 0.

Intra operative changes in basal heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MABP), SPO<sub>2</sub>, ECG were recorded every 5 min in the first 15 min after spinal anesthesia and then every 15 min until the end of surgery.

Post operatively all the patients were monitored every half hourly for vital parameters and the duration of effective analgesia using VAS score.

The duration of analgesia was taken from complete sensory block to the time of first rescue analgesic given when VAS score became 5 or more. Inj diclofenac sodium 1.5mg/kg i.m. was used as rescue analgesic.

Occurrence of nausea, vomiting, hypotension, bradycardia, respiratory depression, ectopic beats and ST-T changes, urinary retention, shivering, and allergic reactions were recorded throughout the study. Bradycardia (fall of 15 pulse rate/min from pre block value) treated with inj atropine 0.6 mg. Hypotension (defined as >20% fall in B.P. from pre block value) was treated with inj mephentermin 6 mg i. v. bolus. Respiratory depression (defined as spo<sub>2</sub> <90% & /or RR<10/minute).

Data were recorded and analyzed by using Microsoft excel. Results on continuous measurements are presented on Mean  $\pm$  standard deviation and results on categorical measurements are presented in a number. Student's paired t test was used to compare the parametric data between the groups. P<0.05 was considered statistically significant.

## **OBSERVATION AND RESULTS**

The demographic data and surgical characteristics were comparable in both groups

(Table 1). The total no. of patients undergone for various types of orthopedic surgeries is shown in Table 2. Onset time for sensory and motor blockade was comparable between both groups. While duration of sensory and motor blockade were longer in B group than A group and the difference was statistically significant p<0.05 (Table 3).

The mean onset time for sensory and motor blockade in group A were 6.81 $\pm$ 0.14 min, 9.45 $\pm$ 0.5 min respectively and in group B were 7.03 $\pm$ 0.38 min, 8.4 $\pm$ 0.7min respectively (p>0.05) which were statistically not significant. The peak sensory level achieved was up to T8 in both the groups. The mean duration time for sensory and motor blocks for Group A were 217.33  $\pm$  3.32 min, 179.00  $\pm$  5.13 min respectively; and in group B were 252.33 $\pm$ 4.12 min., 208.66  $\pm$  4.83min respectively which were statistically significant (p<0.05). The mean duration of analgesia was longer in group B 292 $\pm$ 5.13 min compared to group A 253 $\pm$ 4.13 minutes which was statistically significant. Hemodynamic changes in both the groups as shown in figure 1. Intra operative pulse rate changes were less common in group B compared to group A.

The bradycardia was more common in group A (4/30) as compared to group B (2/30) which was treated with inj atropine 0.6 mg i.v. (p<0.05). Maximum fall in the mean blood pressure was occurred during first half an hour after giving spinal anesthesia. Hypotension occurred more in group A (7/30) then group B (2/30) which was statistically significant. Post operatively all patients remains Haemodynamically stable in both the groups without significant changes. Peri-operative side effects as shown in (Table 4). ST-T changes found more in group A (5/30) patients as compared to group B (1/30) patients.

Ectopic beats were more found in group A as compared to group B. Incidence of pruritus was more common in group B. Shivering, nausea and vomiting were more in group A than group B. no significant incidence of urinary retention or respiratory depression was found in either group.

Table 1: Demographic data

	<b>Group A (N=30) Mean ± SD</b>	<b>Group B (N=30) Mean ± SD</b>
Age(years)	56.96±6.12	58.8±7.12
Sex(M/F)	25:5	20:10
Weight(kg)	59.06±5.12	56.33±4.36
Height(cm)	159.4±4.35	156.83±4.84
Duration of surgery(minutes)	90.16±6.41	83.66±5.35

Table 2: Types of orthopedic surgery

<b>Type of surgery</b>	<b>Group A</b>	<b>Group B</b>
AMP (Austine Moore Prosthesis)	2	7
Naviz Nail	6	7
Ender's Nail	1	4
Thompson Prosthesis	0	1
Tibia I/L (Interlocking)	7	3
STG (Split Skin Graft)	1	1
DHS (Dynamic Hip Screw)	1	2
Excisional biopsy	0	1
CCS(Cannulated Cancellous Screw)	0	2
External fixation	2	1
TBW (Tension Band Wiring) + fibula plating	4	0
ROI (Removal of Implant)	3	0
TBW (Tension Band Wiring) patella	0	1
Gamma Nailing	1	0
Femur I/L (Interlocking)	2	0
Total No of patients	30	30

Table 3: Characteristic of spinal blockade

<b>Sensory and motor block characteristics</b>	<b>Group A (N=30) Mean ± SD</b>	<b>Group B (N=30) Mean ± SD</b>	<b>P value</b>
Highest sensory level	T8	T8	>0.05
Onset of sensory blockade	6.81±0.14	7.03±0.38	>0.05
Onset of motor blockade	9.45±0.52	8.45±0.7	>0.05
Duration of sensory blockade	217.33±3.32	252.33±4.12	<0.05
Duration of motor blockade(minute)	179.00±5.13	208.66±4.83	<0.05
Duration of analgesia(minutes)	253±4.13	292±5.13	<0.05

Table 4: Showing incidence of side effects (intra and post operative period)

<b>Side effects</b>	<b>Group A</b>	<b>Group B</b>
Hypotension ( fall of MAP>20 mm Hg from pre operative value)	7	2
Bradycardia(fall of pulse rate>15/min from pre operative value)	4	2
Respiratory depression (RR<10/min or SPO2<90%)	0	0

Nausea and vomiting	5	1
Shivering	5	11
Urinary retention	1	1
Pruritus	0	3
ST-T changes(Transient ischemic changes)	5	1
Ectopic beats	5	1

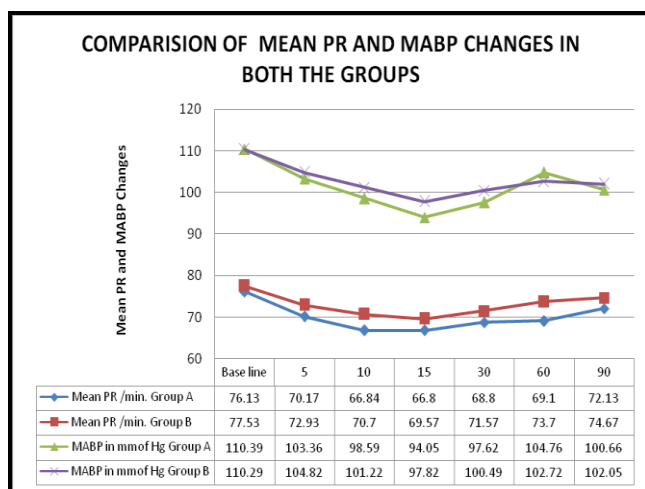


Figure 1: Intra operative mean pulse rate & mean arterial blood pressure changes

## DISCUSSION

During anesthesia primary goals of anesthesiologist is to maintain body physiology as near to normal as possible. The most important determinant of both successful surgical anesthesia and time until recovery is the dose of local anesthetic drug. Significant hemodynamic changes are often seen after spinal anesthesia in hypertensive and elderly patients. A neuraxial administration of opioids in conjunction with local anesthetics improve the quality of intraoperative analgesia, provide good hemodynamic stability and prolongs the duration of post operative analgesia. Most studies have shown that 25 µgm of fentanyl increases duration of post operative analgesia with good hemodynamic stability with minimum side effects like pruritus.<sup>9-12</sup>

Opioid induced sensory changes are not due to their action on ion channels but to the interaction with specific spinal cord receptors acting selectively by decreasing afferent A delta and C fibers impulses by opening presynaptic K<sup>+</sup> channels to inhibit transmitter release and thus reduce calcium influx without affecting posterior root axons and evoked somatosensory potentials. There is also a direct postsynaptic effect with hyperpolarization and reduced neuronal activity. In vitro studies have shown nerve conduction depression when high concentrations are used.<sup>1,3</sup>

Suggested level of spinal anesthesia for lower limb surgery is T10. Recommended dose of 0.5% hyperbaric bupivacaine is 3ml (15mg). Hypotension and bradycardia are normal physiological response during spinal anesthesia because of sympathetic blockade. In hypertensive patients more chances of hypotension and bradycardia during spinal anesthesia because of inherent sympathetic nervous system over activity due to hypertension, so we decided to see the effect in hypertensive patients.

In our present study, we have added 0.5 ml (25µgm) fentanyl, a highly lipophilic opioid to lower dose of 0.5% bupivacaine particularly in hypertensive patients and compared hemodynamic parameters like blood pressure, heart rate, ST-T changes ectopic beats, side effects of fentanyl, duration of analgesia and sensory and motor profiles of block.

In our study 7 patients of group A developed significant hypotension and needed vasopressors compared to 2 patients of group B. and 4 patients developed bradycardia in group A compared to 2 patients of group B treated with inj atropine. In present study it has been observed that maximum change in blood pressure had occurred during first half an hour after giving spinal anesthesia intraoperatively hypotension more common in group A which was statistically significant. Post operatively fall in B. P. more common in group A but it was not significant.

Other studies done by Ben David et al<sup>8</sup>, Alonso chiko et a<sup>9</sup>, Karmaz et al<sup>10</sup>, and Jayshri bogra et al<sup>11</sup> also found that synergism between intrathecal opioids and local anesthetics may make it

possible to achieve reliable spinal anesthesia with greater hemodynamic stability using a low dose of local anesthetic and nearly eliminate the need for vasopressor support. Karim Aschnoune et al<sup>12</sup> found that small dose bupivacaine with sufentanyl prevents cardiac output modifications after spinal anesthesia.

There was no significant difference in the onset time for sensory and motor block in both groups. In our study we found that the duration of effective analgesia and duration of sensory and motor block were significantly more when fentanyl was added to bupivacaine. N Biswas et al<sup>13</sup> found that duration of motor blockade and duration of analgesia was prolonged in fentanyl group while other study done by Singh H et al<sup>14</sup> and they found that duration of sensory block and analgesia was prolonged in fentanyl group. ST-T changes and ectopic beats more found in group A. ST-T changes and ectopic beats in group B present transiently and then disappear spontaneously by giving 100% O<sub>2</sub> without any drug therapy. While out of 5, 2 patients in group A required 100% O<sub>2</sub> and inj. Xylocard (1%) 50 mg intravenously for treatment of ectopic beats. in group A 5 patient in which ectopic beats was present from this 1 patient was given 100% O<sub>2</sub> inj. Xylocard 1% (50+50+50mg) in spite of this treatment ectopic beat 2-3/min continuously present intra operatively and post operatively.

The synergism between intrathecal opioids and local anesthetics may make it possible to achieve reliable spinal anesthesia with minimal hypotension without increasing the extent of sympathetic block.<sup>15</sup> various studies have used various doses of fentanyl intrathecally. Higher doses of opioids are feared to produce high incidence of related side effects.

In present study, none of the patients in either group had respiratory depression. Bogra jaishree et al<sup>11</sup> studied synergistic effect of intrathecal fentanyl and bupivacaine in spinal anesthesia for cesarean section and concluded that respiratory depression do not occur with fentanyl. In our study nausea and vomiting were observed more frequently in group A (5/30) patients as compared to group B (1/30). Similarly M

seyedhejazi et al<sup>16</sup> found the effect of intrathecal bupivacaine with fentanyl in cesarean section and concluded the incidence of nausea and vomiting is less in bupivacaine with fentanyl group.

In present study none of group A patients while 3/30 patients of group B developed pruritus which is mild in character. Kan FC et al<sup>17</sup> studied subarachnoid fentanyl with diluted small dose bupivacaine for cesarean section delivery and found that incidence of pruritus was much more common in fentanyl group.

Two patients in either group in this study found post operative urinary retention. Group A (5/30) patients developed shivering which was treated with inj. tramadol and inj. Avil while in group B only 1 patient developed shivering. Karamaz A et al<sup>10</sup> studied effect of bupivacaine with fentanyl in elderly patients undergoing transurethral prostatectomy and concluded that incidence of shivering was significantly less common in bupivacaine with fentanyl group.

## CONCLUSION

From our study it was concluded that use of intrathecal fentanyl 25µgm as adjuvants to Bupivacaine Heavy 12.5mgm in controlled hypertensive patients can be a safer alternative with less side effects. B+F increases hemodynamic stability in the form of less hypotension, less requirement of vasopressors, bradycardia, ST-T changes, ectopic beats, and shivering increased duration of sensory blockade, motor blockade, and provides an effective surgical anesthesia with decrease dose of local anesthetic agent. The significantly prolonged duration of analgesia decreases the need for any additional analgesics.

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