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Spinal anesthesia with low dose bupivacaine and fentanyl for femur surgeries in elderly patients

Abstract

Background and objectives: Decreasing the dose of intrathecal Bupivacaine may be useful to provide surgical anaesthesia with less hemodynamic disturbances especially in elderly patients but may be associated with inadequate anaesthesia for orthopaedic surgeries to perform. This can be overcome by adding Fentanyl to it. Materials and method: 60 elderly patients of American Society of Anaesthesiologists (ASA) grade II, scheduled for femur surgeries were randomly assigned to one of the two groups. Group B:(n=30) patients receiving Bupivacaine (0.5%) heavy 2.5ml (12.5mg) and Group BF:(n=30) patients receiving Bupivacaine (0.5%) heavy 1.5ml (7.5mg)+Fentanyl (25ug) 0.5ml+0.5 ml normal saline, total volume being 2.5ml. The characteristics of sensory and motor blockade, duration of effective analgesia, perioperative hemodynamics and complications were recorded.

Results: The mean onset of sensory block and time to achieve peak sensory level was early, time to achieve regression to L1 level and duration of effective analgesia was longer in group BF ad the difference was highly significant ($p<0.001$). There was no significant difference in motor blockade characteristics between two groups. Incidences of hypotension were more in group B compared to group BF.

Conclusion: Low dose intrathecal bupivacaine (7.5 mg) with fentanyl (25mcg) can provide adequate surgical anaesthesia and better hemodynamics and can be used in elderly patients for femur surgeries.

Keywords: fentanyl, bupivacaine, spinal anesthesia, femur surgeries

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Devyani Desai,[1] Pinal Bumiya,[2] MR Upadhyay,[3] Ambarish Vashishtha[4]

[1]Associate Professor, Department of Anesthesiology, Medical College and SSGHospital, India

[2]Assistant Professor, Department of Anesthesiology, Medical College and SSGHospital, India

[3]Professor and Head, Department of Anesthesiology, Medical College and SSGHospital, India

[4]Ex Student, Department of Anesthesiology, Medical College and SSGHospital, India

Correspondence: Devyani Desai, Department of Anesthesiology, Government Medical College, Vadodara, India, Tel 919909983168 Email devyani.dr@gmail.com

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Introduction

Spinal anesthesia is one of the most commonly used anaesthesia technique for lower abdominal and lower limb surgeries due to its well-known advantages.[1] Bupivacaine has comparatively longer duration of action i.e. 2 to 2.5 hours and lower incidence of transient radicular irritation than Lignocaine, it is used widely for spinal anesthesia now a days.[2,3] Many drugs have been used as adjuvants to Bupivacaine in spinal anesthesia for prolongation of its action as there is a complex system of interaction of different receptors for the transmission and inhibition of nociception in the spinal cord.[4] Studies have established that opioids and local anesthetics administered together intrathecally have potent synergestic analgesic effect, enhancing the sensory blockade without altering the degree of sympathetic blockade ensuring better hemodynamic.[5] Fentanyl is a μ receptor agonist, with an analgesic potency greater than morphine, pethidine and alfentanil. Analgesia is produced primarily by interaction with μ receptors at supraspinal sites. It also binds to kappa receptors but not with lesser degree within spinal cord.[1–3,6] However, spinal anaesthesia with the conventional dose Bupivacaine has got its own inherent complications like hypotension which can become detrimental for elderly patients. Several studies using the low dose intratheacal Bupivacaine with varying doses of Fentanyl (10 and 25μg) have demonstrated adequate surgical anesthesia with good haemodynamic stability.[7–10] So, we decided to undertake this study to compare 7.5mg Bupivacaine with 25 μg Fentanyl against conventional dose of hyperbaric Bupivacaine 12.5mg.

Materials and method

After the approval of hospital ethical committee, a randomized prospective clinical study was conducted on 60 elderly patients having age ≥65 years, of ASA physical status II, posted for femur surgeries and able to understand test regarding assessment of sensory and motor block and test regarding assessment of pain. Patients with any contraindications to spinal anesthesia, prior history of opioid and other substance abuse, history of drug allergy, patients unwilling to participate in study, ASA physical status ≥III and patients with unstable angina and severe aortic stenosis were excluded. All the selected patients were explained about the purpose, procedure and side effects of the study. They were also explained about assessment of pain with the help of Visual Analogue Scale. After this a written and informed consent was taken. Using MedcalC software and taking and α error of 0.01 and β error of 0.01 for the parameter "duration of effective analgesia", the minimum sample size required to conduct the study was 22 per group. In order to compensate for the greater variability, 30 patients were included in each group. Tab. Alprazolam (0.25mg) and Tab Ranitidine (150mg) were given to all patients previous night before surgery.

Patients were randomly assigned in one of the following two groups to receive either:

Group B: (n=30) patients receiving Bupivacaine (0.5%) heavy 2.5ml (12.5mg)

Group BF: (n=30) patients receiving Bupivacaine (0.5%) heavy 1.5ml (7.5mg)+Fentanyl (25ug) 0.5ml+0.5 ml normal saline.

Total volume injected was 2.5ml in both the groups. All the patients were premedicated with Inj. Ondansaterone (4mg) and Inj. Glycopyrrolate 0.2 mg intravenously before induction. After pre loading with Inj. Ringer lactate 8 ml/kg in all patients over 30 minutes, spinal anaesthesia was given under all aseptic and antiseptic precautions using 23G Quincke's needle in sitting position. Patients were turned supine immediately at the end of the injection, time of which was defined as 'zero'. Patients having nil or inadequate surgical anaesthesia were excluded from the study. Sensory block was assessed using pin prick method and motor block as per Bromage scale every 15 seconds. Following parameters were observed.

Sensory Block

Sensory block was noted as follows

1) Onset of sensory block: Loss of pin prick sensation at L1 dermatome.
2) Highest sensory level: Checked until sensory level remained same for 4 consecutive reading
3) Time to achieve highest level:
4) Regression time to L1 level from highest sensory level.

Motor Block

Motor block was noted as follows.

1) Onset of motor block (time to achieve grade I motor block)
2) Maximum motor block achieved – Level of motor block was checked until motor Bromage grade was same for 4 consecutive readings and that time was noted.
3) Time to achieve maximum motor block (Grade III)
4) Recovery from motor block – Time to achieve Grade 0 again

Bromage grade: Grade 0-no motor block

Grade I - unable to flex hip

Grade II - unable to flex knee

Grade III - unable to flex ankle

Vital parameters were monitored at 1, 3 and 5 minutes, every 5 minutes till 20 minutes and then after every 15 minutes till the end of surgery. Fall in the systolic blood pressure and pulse rate of >20% from the pre block value were considered as hypotension and bradycardia respectively. Hypotension was treated with 100% oxygen, intravenous fluids and vasopressor (ephedrine) if required and bradycardia was managed by Inj Atropine 0.6mg intravenously. SpO_2 <90% and respiratory rate≤8 per minute were considered as respiratory depression. Patients were observed for other peri-operative complications like nausea-vomiting, shivering, high spinal anesthesia, pruritus etc. All patients were monitored post operatively for vital parameters, analgesia and complications at every 30 minutes. A linear visual analogue scale of 10 cm was used graded from 0-10 (0=No pain and 10=Worst pain) and the patient was asked to mark the point on the scale that corresponded to the level of pain. Rescue analgesia was given in the form of Inj. Diclofenac 75 mg intramuscularly when VAS score became ≥ 4. That time was taken as end point of our study. The results of the study were tabulated in mean±SD and statistically compared using MedcalC software. Chi square test was used for qualitative data (ASA grade, motor grade) and for rest of the quantitative data, student't' test (paired and unpaired) was used. The p-value was considered significant if <0.05 and highly significant if <0.01.

Results

The two groups were comparable to each other with respect to age, sex, mean duration of surgery and ASA physical status (Table 1). The mean onset of sensory block was 126.7±26.14 seconds in Group B while in Group BF, it was 81.96±27.54seconds. The peak sensory level, achieved was T6-T8 (20:10) in group B and T8-T10 (14:16) in group BF. Time taken to achieve peak level in Group B was 249.5±10.93 seconds, whereas in Group BF it was 134.2 ±7.88 seconds. Thus onset and peak level was achieved much faster in Group BF than Group B and the difference was statistically highly significant (p<0.001). Regression time to L-1 level was longer in BF group in comparison to group B. (117.66±5.83 v/s 104.5±7.23 minutes, p<0.001) (Table 2). In group B, Bromage grade II motor block was achieved in 5 patients and grade III in 25 patients whereas in group BF this ratio was 18:12. There was no difference in other motor block characteristics (Table 3). The duration of effective analgesia was significantly longer in Group BF than group B. It was 117.66±11.04 minutes in Group B and 225.5±13.82 minutes in group BF (p<0.001) (Graph 1).

There was a fall in mean pulse rate was more in group B compared to group BF but in both the groups pulse rate did not fall beyond 75/min (Graph 2). There was a fall in blood pressure in both the groups after giving spinal anaesthesia and comparing the two groups, there was statistically significant change in systolic blood pressure which persisted till 1 hour and then it became insignificant (Graph 3). 2 patients (6.66%) in group B and 1 patient (3.33%) in Group BF had bradycardia which was treated with Inj. Atropine 0.6 mg intravenously. In the Group B, 8 patients (27%) had hypotension whereas in Group BF, 3 patients (10%) had hypotension which was treated with intravenous fluids, 100% O_2 and/or vasopressors (ephedrine). No other intra and postoperative complications were observed in both the groups.

Table 1 Demographic data of both the groups

Group	Group B	Group BF	P value
Age in years (mean ± sd)	66.6±1.57	67.50±2.90	>0.05
Sex (male:female)	19:11	20:10	
ASA grading (II)	30	30	
Mean duration of surgery(minutes)	117.16±14.67	115.13±12.90	>0.05

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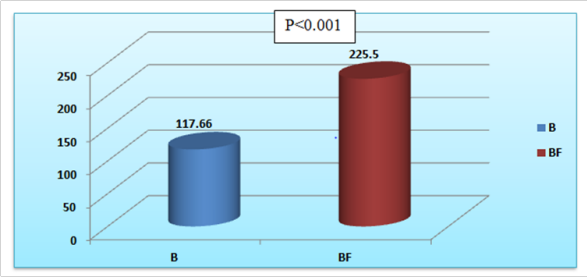
Table 2 Assessment of sensory block

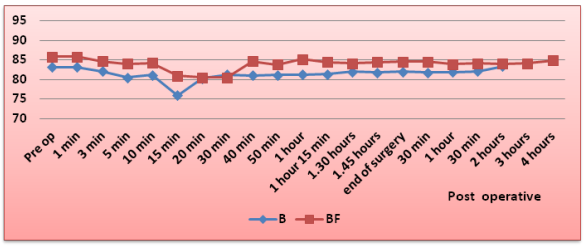
	Parameter	Group B	Group BF	p value
1	Onset of sensory block (seconds)	126.7±26.14	81.96±27.54	<0.001
2	Peak sensory level achieved	T6-T8 (67%-33%)	T8-T10 (47%-53%)	
3	Time to achieve peak level (seconds)	249.5±10.93	134.2±7.88	<0.001
4	Two segment regression time (minutes)	104.5±7.23	117.66±5.83	<0.001

Table 3 Assessment of motor block

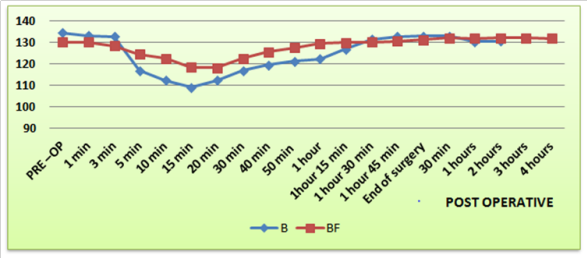
	Parameter	GROUP B	GROUP BF	P value
1	Onset of motor block (seconds)	127.4±3.79	127.93±3.17	>0.05
2	Maximum Bromage score achieved (II:III)	05:25 (17%-83%)	18:12 (60%-40%)	
3	Time to achieve maximum level (seconds)	134.26±3.26	137.83±4.69	>0.05
4	Recovery of motor block (minutes)	137.76±3.43	135.35±5.43	>0.05



Graph 1 Post operative Duration of Analgesia (minutes).



Graph 2 Mean Pulse Rate.



Graph 3 Mean Systolic Blood Pressure (mmHg).

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Discussion

Bupivacaine given alone intrathecally in elderly patients may lead to significant undesired haemodynamic disturbances. On the other hand, using bupivacaine in low doses may not be adequate for surgical requirements.[9]Combining fentanyl with low dose bupivacaine not only provides adequate surgical anaesthesia but there is also minimal haemodynamic adverse effects.[10] It has been well documented that the combination of opioid and local anesthetics administered intrathecally potentiates local anaesthetic analgesia. Opioids however act through various receptors.[1,2] Most commonly used intrathecal opioids are μ agonist drugs which provide excellent analgesia but carry along with them various μ mediated side effects.[9] Eventually it was established that significant analgesia can be obtained by kappa binding sites with the added advantage of bypassing μ related side effects.[5,6] Fentanyl being a μ receptor agonist, analgesia is produced primarily by interaction with μ receptors at supraspinal sites but it also binds to kappa receptors.[1–3,6]

A number of studies have used 25μg of intrathecal fentanyl as an adjunct to the anesthetic agent with good results. A few studies have used intra-thecal fentanyl in <25μg dose, but most studies have shown that 25μg of fentanyl provides maximum duration of post-operative analgesia with minimal side effects like respiratory depression and pruritus.[10–15] So, we decided to use 7.5mg Bupivacaine with 25μg Fentanyl in our study to be compared with conventionl dose of hyperbaric Bupivacaine 12.5mg. As in our results, Lalita Gauri Mitra et al,[5] and Diana Fernandez et al.[11] observed faster onset of sensory effect. Lalita Gauri Mitra et al.[7] Bruce Ben David et al,[8] K Jain et al,[11] and P Patra et al,[12] found prolongation of sensory block with addition of Fentanyl to Bupivacaine. A synergism was observed between intra thecal Fentanyl and Bupivacaine, the two exert their antinociceptive effect in the spinal cord by different mechanisms. The μ agonist Fentanyl, exerts its action by inhibition of synaptic transmission in nociceptive afferent pathway (Aδ& C fibers) by opening pre synaptic potassium channels to inhibit transmitter release and by reducing calcium influx. Local anaesthetics work primarily by causing blockade of voltage gated sodium channels in the axonal membrane and further effect on pre synaptic inhibition of calcium channels. Synergistic blockade of Aδ& C fibers by intrathecal Fentanyl and local anaesthetics may explain the early onset and prolonged duration of sensory block in Fentanyl group.[1–3,6]

Even though the maximum Bromage score of motor block was lesser in group BF, none of our patients complained discomfort during surgery and did not need any supplementation of sedation and all surgeons were also satisfied with the same intensity of motor block. Lalita Gauri Mitra et al, Kararmaz et al. and C Olofsson et al, also did not observe any difference in motor blockade with addition of Fentanyl.[11,15,16] Fentanyl has differential synergism with local anaesthetic agents and acts on only Aδ& C fibres so it cannot add to motor blockade of local anaesthetic agent.[1–6,15,16] Results of our study showed that addition of Fentanyl (25μg) to Bupivacaine (7.5 mg) given intrathecally provided better haemodynamic stability compared to bupivacaine 12.5 mg dose given without Fentanyl in elderly patients as significant fall in systolic blood pressure was noted in Group B compared to group BF. More number of patients in group B (27%) experienced hypotension than in group BF (10%). Lalita Gauri Mitra et al. also observed hypotension in more number of patients (13/31) in group B compared to group BF (4/31) and the requirement of Mephantermine also was higher in group B than Group BF (7.5±4.5 versus 3.0±0 mg).[11] K Jain et al,[8] Kararmaz et al,[10] Volpin et al,[16] and C Olofsson et al,[17] also observed good haemodynamic stability with low dose Bupivacaine and Fentanyl.[8,10,16,17] Intrathecal Fentanyl neither alone nor in combination with Bupivacaine, depresses the sympathetic activity but when bupivacaine is used in low dose, segmental sympathetic blockade is less which in turn provides better haemodynamic.[1,12] Martyr and Clark recommended less than 10mg of Bupivacaine to avoid hypotension in elderly patients.[19] In our study, incidences of bradycardia were more with the higher dosage of Bupivacaine and were managed successfully. Lalita Gauri Mitra et al.[11] observed nausea and pruritus in Fentanyl group in their study. Pruritus was also seen in the study of Pramod Patra et al.[12] only in fentanyl treated patients[11,12,18] but was not seen in any case in our study.

Conclusion

Low dose Bupivacaine (7.5 mg) with Fentanyl (25μg) can provide adequate surgical anaesthesia and better haemodynamic and can be used in elderly patients for lower limb orthopaedic surgeries.

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Nill.

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Conflicts of interest

Author declares that there is no conflict of interest.

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