 DOI: 10.18231/2394-4994.2017.0012

Comparative study of two doses of bupivacaine along with fentanyl citrate in spinal anaesthesia for short surface surgeries below umbilicus

Kalpeshkumar Mistry[1,*], Ankur Gandhi[2]

[1,2]Assistant Professor, Dept. of Anaesthesia & Critical Care, Geetanjali Medical College & Hospital, Udaipur, Rajasthan

***Corresponding Author:**
Email: drkalpesh001@gmail.com

Abstract

Background: Intrathecal opioids are synergistic with local anaesthetics and intensify the sensory block without increasing the motor block and offer haemodynamic stability. This study was planned to compare the effects of low doses and high dose bupivacaine along with fentanyl citrate.

Methods: This study was carried out in patients presenting for short surface surgical procedures below umbilicus from physical state ASA grade I and II. 60 Patients were randomly allocated in to **Group BF 5** [Inj. Bupivacaine Hydrochloride 5 mg + Inj. Fentanyl citrate 25 µg] and **Group BF 7.5** [Inj. Bupivacaine Hydrochloride 7.5 mg + Inj. Fentanyl citrate 25 µg] of 30 each. Sensory and motor block were assessed. Patients were observed for both intraoperative and postoperative complications.

Results: Mean levels of sensory blockade to pinprick were T10 in group BF5 and T8 in group BF7.5. Total duration of sensory blockade (175.3±14.56 min) and motor blockade (129.5±19.09 min) were significantly higher in group BF7.5. Hypotension was seen in 7 patients of BF7.5 as compared to just 2 patients in group BF5. None of the patients from either group had bradycardia and respiratory depression. Incidences of shivering, pruritus and headache were similar in both groups.

Conclusion: Both doses of bupivacaine hydrochloride 5 mg and 7.5 mg with fentanyl citrate 25 µg intrathecally provide successful anaesthesia below T10 spinal segment. However, 7.5 mg dose is associated with denser block, increased incidence of hypotension, delay in achieving highest sensory blockade and delayed recovery which delayed ambulation and discharge time following short surgical procedures.

Keywords: Bupivacaine, Intrathecal, Opioids, Short surface surgeries below umbilicus

Introduction

Spinal anaesthesia is the regional anaesthesia obtained by blocking the spinal nerves in the subarachnoid space. The anaesthetic agents are deposited in the subarachnoid space and act on spinal nerve roots and not on the substance of the cord.[(1)] Spinal anaesthesia has been popular for short and intermediate duration of surgical procedures.

Lidocaine has been the local anaesthetic of choice for spinal anaesthesia in ambulatory surgical procedures since decades. This was based on drug's short duration of action which allows timely recovery and discharge. Unfortunately recent reports of lidocaine neurotoxicity have created doubt on the use of lidocaine. One study reported 37% incidence of "radicular symptoms" of pain and/or dys-aesthesias in buttocks, thighs, or lower limbs after spinal anaesthesia with 5% lidocaine in 7.5% glucose.[(2)] For these reasons, bupivacaine hydrochloride has become popular for ambulatory short surgical procedures.[(3)]

Bupivacaine hydrochloride being a potent local anaesthetic, it has propensity to cause severe hypotension due to sympathetic blockade when given intrathecally, particularly in geriatric patients. So low dose bupivacaine hydrochloride was tried intrathecally as a solo agent which often did not provide adequate sensory blockade.[(4)]

Intrathecal opioids are synergistic with local anaesthetics and intensify the sensory block without increasing the motor block and offer haemodynamic stability.[(5,6)] The combination makes it possible to achieve spinal anaesthesia with otherwise inadequate doses of local anaesthetics. As intrathecal morphine is associated with higher incidence of side effects, newer opioid like fentanyl citrate is combined with local anaesthetics which has milder side effects.[(7)] Also fentanyl citrate is a lipophlic drug so it has a rapid onset compared with lipophobic opioid such as morphine. This property may affect the onset of sensory block when fentanyl citrate is added to bupivacaine hydrochloride for subarachnoid block.[(8)] So this study was planned to compare the effects of low doses and high dose hyperbaric bupivacaine hydrochloride intrathecally along with a fixed dose of fentanyl citrate for short surface surgeries below umbilicus.

Materials & Methods

After getting approval from the ethical committee of our hospital, the study was carried out in patients presenting for short surface surgical procedures below umbilicus level like amputation of penis, transurethral resection of prostate, intracavitory radiotherapy for cervical cancer, soft tissue sarcoma of lower limb etc. Patients with infection at the site of injection, abnormalities of spine, coagulopathies, severe cardiac and respiratory disease, history of allergy to used drug, anticipated difficult airway were excluded from the study. The patients were selected randomly from physical state ASA grade I and II using computer generated randomized numbers. Pre anesthetic check-

up and routine investigations were done in all cases and special investigations were done where indicated. Complete hemogram, bleeding time, clotting time, random blood sugar, serum creatinine, blood urea, blood grouping and chest x-ray were done as routine investigations and if required electrocardiogram, 2D echo and ultrasound were also conducted. Written informed consent was taken from all the patients.

Patients were randomly allocated in to **Group BF 5** [Inj. Bupivacaine Hydrochloride 5 mg (0.5%) Heavy + Inj. Fentanyl citrate 25 µg] and **Group BF 7.5** [Inj. Bupivacaine Hydrochloride 7.5 mg (0.5%) Heavy + Inj. Fentanyl citrate 25 µg]. 2ml injection was given in each group after taking both bupivacaine and fentanyl in single syringe from their ampoule.

Patients were put in left lateral position followed by painting and draping of back taking aseptic precautions. After local infiltration, intrathecal space was accessed by spinal needle and drugs according to group allotted were given in L3-L4 interspinous space. Patients were immediately turned supine. Sensory level for block was tested every 2 minutes until level was constant for 4 consecutive tests. Sensory block was assessed with 24 Gauge needle by eliciting pin prick and level was confirmed. Motor block was assessed at the time of reaching highest sensory block, by Bromagescore[9] which is as follows: 0 - Full flexion of knees and feet, 1 - Just able to flex knees, full flexion of feet, 2 - Unable to flex knees , some flexion of feet possible, 3 - Unable to move legs or feet.

Sensory level for block were tested every 2 min until level was constant for 4 consecutive tests. Test was then conducted every 10 min till 2 segment regression was achieved 2 dermatomal level below the highest blockade level. Testing was continued at 20 min interval till recovery of the S2 segment and complete reversal of sensory blockade.

Heart rate, blood pressure, SPO_2 and respiratory rate were noted every 1 min for the first 10 min, then every 5 min till 60 min and then every 15 min. Hypotension was defined as Systolic blood pressure less than 90 mm Hg or 30% decrease in systolic blood pressure from base line and bradycardia was defined as heart rate less than 50 / min. Hypotension was treated by increasing the rate of IV fluid and if required by Inj. Mephentermine 5 mg IV in incremental doses. Bradycardia was treated by Inj. Glycopyrrolate 0.2 mg IV + IV bolus 100 ml normal saline and if it was not corrected then injection atropine 0.6 mg IV. Again repeat dose of atropine if it was not corrected.

Patients were observed for both intraoperative and postoperative complications like hypotension, bradycardia, respiratory depression, nausea, vomiting, rigors and pruritus, or retention of urine. Vital signs were recorded every 30 min for 3 hours and hourly thereafter for 12 hours.

Mean and standard deviation were calculated for each parameter. For qualitative variables chi-square test was performed and for quantitative variables student's 't' test was used. P values < 0.05 were considered significant.

Results

Total 60 patients were recruited during study period; 30 patients in each of the study groups. There were no differences between demographic characteristics of the two groups with respect to age, weight, height, systolic and diastolic pressures, heart rate and respiratory rate. (Table 1 and 2)

Table 1: Demographic profile of both the groups

	Group BF 5	Group BF 7.5	P value
Age (yrs)	51.8 ± 12.1	52.7 ± 13.9	p>0.05
Weight (kg)	51.4 ± 8.3	51.2 ± 8.7	p>0.05
Height (cm)	166.1 ± 5.2	167.8 ± 5.8	p>0.05

p>0.05 (non-significant), p < 0.01(significant)

Table 2: Basal hemodynamic parameters of both the groups

	Group BF 5	Group BF 7.5	P value
Basal systolic blood pressure (mm Hg)	129.8 ± 17.1	132.7 ± 14.7	p>0.05
Basal diastolic blood pressure (mm Hg)	82.6 ± 12.6	84.1 ± 18.8	p>0.05
Basal heart rate (/min)	92.2 ± 16.6	95.6 ± 16.0	p>0.05
Basal respiratory rate (/min)	17.9 ± 1.9	17.2 ± 2.3	p>0.05

p>0.05 (non-significant), p < 0.01(significant)

Table 3: Characteristics of sensory and motor blocks in both the groups

	Group BF 5	Group BF 7.5	P value
Highest level of sensory block	T 10	T 8	--
Time to reach highest level (min)	6.37 ± 1.45	9.13 ± 2.23	p< 0.01
Time to 2 seg regression (min)	66.5 ± 11.53	79.6 ± 14.71	p< 0.01
Time to S2 seg regression (min)	91.6 ± 14.52	115.3 ± 15.03	p< 0.01
Duration of motor blockade (min)	109 ± 15.28	129.5 ± 19.09	p< 0.01
Duration of sensory blockade (min)	148.8 ± 14.72	175.3 ± 14.56	p< 0.01

p>0.05 (non-significant), p < 0.01(significant)

Mean levels of sensory blockade to pinprick were T10 in group BF5 and T8 in group BF7.5. Times to

reach highest level of sensory blockade, 2 segment regression time, S2 segment regression time and total duration of sensory blockade and motor blockade were significantly higher in group BF7.5. (Table 3)

94% of the patients in group BF7.5 had motor blockade of Bromage score 3 as compared to only 60% patients in group BF5. None of the patient in either group had motor blockade of Bromage score 0. Table 3 shows distribution of all the patients of both the groups according to Bromage score but motor blockade was found significantly higher in group BF7.5. P value was found <0.01. (Table 3 and 4)

Table 4: Bromage score for motor blockade in both the groups

Bromage	Group BF 5	Group BF 7.5
0	0	0
1	01 (3 %)	01 (3 %)
2	11 (37 %)	01 (3 %)
3	18 (60 %)	28 (94%)

It was found that decrease in systolic blood pressure at 20, 30 and 45 min time interval in group BF7.5 were significant as compared to group BF5 and diastolic blood pressure at only 45 min time interval in group BF7.5 was significant compared to group BF5.(Fig. 1)

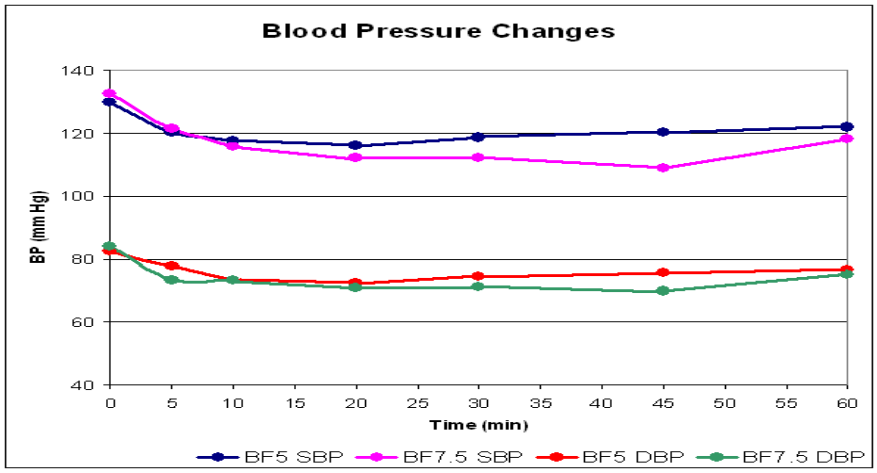

Fig. 1: Comparison of systolic and diastolic blood pressure changes in both the groups

There was no significant difference in pattern of decrease in heart rate in both the groups and there was also no significant difference in decrease in respiratory rate in two groups. (Fig. 2)

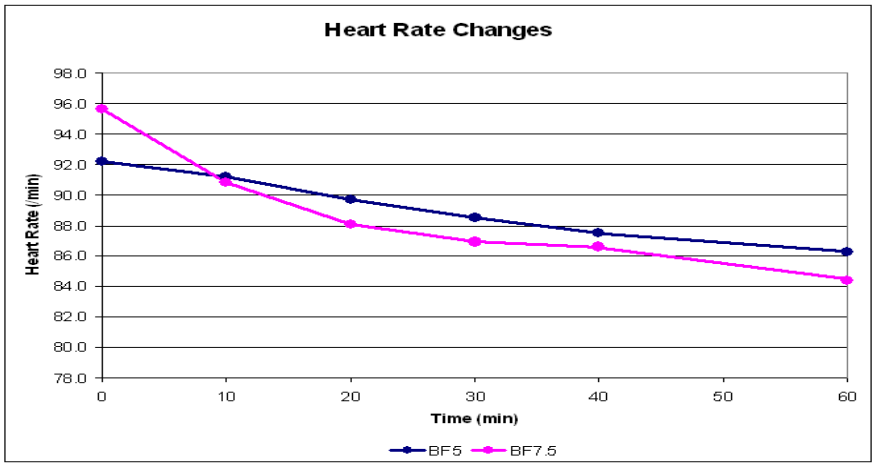

Fig. 2: Comparison of heart rate changes in both the groups

Hypotension was seen in 7 patients of BF 7.5 as compared to just 2 patients in group BF5. None of the patients from either group had bradycardia and respiratory depression either intraoperative or postoperative. Incidences of shivering, pruritus and headache were quite similar in both groups. (Table 5)

Table 5: Complications in both the groups

	Group BF 5	Group BF 7.5
Intraoperative complications		
Hypotension	2	7
Bradycardia	0	0
Nausea, Vomiting	0	0
Shivering	3	3
Pruritus	1	1
Respiratory Depression	0	0
Postoperative complications		
Respiratory Depression	0	0
Headache	5	4
Pruritus	3	2
Nausea, vomiting	1	4

Discussion

The study demonstrates that use of low dose hyperbaric bupivacaine hydrochloride 5 mg or 7.5 mg with fentanyl citrate 25 µg intrathecally provides successful anaesthesia for short surface surgical procedures below umbilicus. Spinal anaesthesia with hyperbaric bupivacaine hydrochloride 5 mg or 7.5 mg alone for such surgical procedures may not provide consistent dense enough block to prevent occasional discomfort or pain during the procedure. These findings that the addition of intrathecal fentanyl citrate to spinal bupivacaine hydrochloride improved quality of block and increased duration of sensory blockade agree with those documented by David et al in their study.[10] With the use of any drug in the subarachnoid space, the potential for neurotoxicity must be considered. Animal and human studies have demonstrated the safety of bupivacaine hydrochloride and fentanyl citrate in this regard.[9,11,12] None of the patients in this study experienced any neurological complications postoperatively.

Mean level of highest sensory blockade was T10 in Group BF5 and T8 in Group BF7.5. Also the mean time to reach highest level was significantly higher in Group BF7.5 (9.13 min) compared to Group BF5 (6.37 min). Bupivacaine hydrochloride given intrathecally first gets diluted in CSF, followed by diffusion within CSF, then there is uptake by the nervous tissue[2]. As in Group BF7.5 the dose of bupivacaine hydrochloride is 7.5 mg, it took higher time to get diluted and get distributed, in addition it occupied more CSF volume. Dose, volume, concentration and baricity are major factors for intrathecally administered solutions. This explains higher level of sensory blockade and more time to reach highest sensory level in Group BF7.5.[3,13]

In this study, adequate analgesia was achieved in both groups and none of the patients required additional pain relief during intra-operative period. Studies have proved consistent synergism between spinal opioids and local anaesthetics.[10,14,15] Bupivacaine hydrochloride 7.5 mg achieved critical concentration for motor blockade in 94% of the patients while bupivacaine hydrochloride 5 mg failed in 40% of patients in Group BF5 to achieve complete motor paralysis but sensory levels were adequate in all patients to proceed with surgery. This meant early recovery of motor functions after spinal anaesthesia in Group BF5 which allowed early ambulation. Motor blockade requires higher dose and concentration of local anesthesia in CSF compared to sensory blockade but lower dose has better hemodynamic stability and less side effects as compared to higher dose.[13,16]

The time to reach 2 segment regression, S2 segment regression, total duration of sensory and motor blockade were significantly more prolonged in Group BF7.5 compared to Group BF5. This suggest that bupivacaine 7.5 mg achieved higher concentration in CSF after dilution thus achieving denser block of the different modalities of nerve fibres in spinal nerves compared to 5 mg. David et al reported that after intrathecal bupivacaine hydrochloride 5 mg without or with fentanyl 10 µg, mean times to voiding and to discharge were 169 min and 187 min respectively, versus 177 min and 195 min respectively.[10] They concluded that addition of 10 µg fentanyl citrate to spinal anaesthesia with small dose bupivacaine hydrochloride intensified the sensory block without increasing the intensity of motor block or prolonging recovery to micturition or street fitness.

Hypotension occurred in 7 patients in Group BF7.5 compared to just 2 patients in Group BF5. Spinal anaesthesia causes hypotension by interruption of efferent sympathetic transmission and sympathetic blockade is usually 2 to 4 segments higher than analgesic blockade level. It can be derived that Group BF7.5 patients had higher blockade of sympathetic outflow compared to Group BF5 patients which explains significant decrease in systolic blood pressure. While in case of diastolic blood pressure mean decrease was not significantly different in two groups for most of the duration after spinal injection. Diastolic blood pressure depends on intravascular volume. Pre-loading of 500 ml Inj. Ringer Lactate was done in all patients.

There was no significance difference in heart rate at any time interval. Bradycardia is expected after spinal anaesthesia because of blockade of sympathetic cardiac accelerating fibres lying from T1 to T4 leveland these fiberes escaped blockade in both groups.

In present study, there was no respiratory depression in any of the patients intra or post operatively. Respiratory depression could be due to

spinal opioids or due to benzodiazepines used.[5] In view of this we used minimal dose of benzodiazepines pre-operatively and none per-operatively. Varrassi et al demonstrated that spinal fentanyl citrate 25 µg in elderly non pre-medicated patients did not cause respiratory depression but 50 µg did.[12] Hypotension occurred in 7 patients in Group BF7.5 compared to 2 patients in Group BF5. None of the patients developed bradycardia or respiratory depression in either of the groups. Pruritus was found in both the groups' patients (4 in Group BF5 and 3 in Group BF7.5) both intra and postoperatively. Most likely cause may be spinal opioid which has a direct central effect on opioid receptor in substantia gelatinosa. This is supported by fact that opioid antagonist naloxone reverses this effects.[17] Lui et al gave intrathecal lidocaine 5% with and without 20 µg fentanyl citrate in 8 volunteers. Pruritus occurred in all volunteers who received intrathecal fentanyl citrate.[15]

Shivering occurred in 3 patients in each group. It can be due to fast intravenous fluids and vasodilatation of cutaneous blood vessels causing increased heat loss.[18] Four patients had nausea and vomiting in Group BF7.5 compared to 1 in Group BF5. Intra-operative nausea and vomiting during spinal anaesthesia is related to hypotension, hypoxia and post-operatively due to sudden changes in position. As hypotension occurred more frequently in Group BF7.5, this explains higher incidence in Group BF7.5. Incidence of headache was not much different in both groups. Headache after spinal anaesthesia is due to CSF leak through the dural puncture site which causes decrease in CSF pressure irrespective of intrathecal doses of bupivacaine hydrochloride or fentanyl citrate.[19]

Conclusion

This study demonstrates that both doses of hyperbaric bupivacaine hydrochloride 5 mg and 7.5 mg with fentanyl citrate 25 µg intrathecally provide successful anaesthesia for short surface surgical procedures below T10 spinal segment. However, bupivacaine hydrochloride 7.5 mg with fentanyl citrate 25 µg is associated with denser block, increased incidence of hypotension, delay in achieving highest sensory blockade and delayed recovery from sensory and motor blockade which delayed ambulation and discharge time following short surgical procedures. Intrathecal fentanyl citrate 25 µg is not associated with respiratory depression and it has synergistic analgesic effects with intrathecal bupivacaine hydrochloride.

References

1. Imbelloni LE. Spinal hemianesthesia: Unilateral and posterior. Anesth Essays Res 2014;8(3):270–6.
2. Hampl KF, Schneider MC, Ummenhofer W, Drewe J. Transient neurologic symptoms after spinal anaesthesia. AnaesthAnalg 1995;81:1148-53.
3. Wason R, Gogia A, Sahni A, Rupam. Comparison of hypobaric, isobaric hyperbaric bupivacaine for comparison of hypobaric, near isobaric and hyperbaric bupivacaine for spinal anaesthesia in patients undergoing knee arthroscopy. Indian J Anaesth 2002;46(6):445-8.
4. Kumar S and Bajwa SJS. Neuraxial opioids in geriatrics: A dose reduction study of local anesthetic with addition of sufentanil in lower limb surgery for elderly patients. Saudi J Anaesth 2011;5(2):142–9.
5. Fernandez-Galinski D, Rue M, Moral V, Castells C, Puig MM. Spinal anaesthesia with bupivacaine and fentanyl in geriatric patients. Anaesthesia Analgesia 1996;83(3):537-41.
6. HJ Priebe: The aged cardiovascular risk patient. Br J Anaesth 2000;85(5):763-8.
7. Khanna MS, Singh IKPG. Comparative evaluation of bupivacaine plain versus bupivacaine with fentanyl in spinal anaesthesia in geriatric patients. Indian J Anaesth 2002;46(3):199-203.
8. Chavan SG, Koshire AR, Panbude P. Effect of addition of fentanyl to local anesthetic in brachial plexus block on duration of analgesia. Anesth Essays Res 2011;5(1):39-42.
9. Kararmaz A, Kaya S. Low dose bupivacaine-fentanyl spinal anaesthesia for transurethral prostatectomy. Anaesthesia 2003;58:526-30.
10. David BB, Solomon E, Levin H. Intrathecal fentanyl with small dose bupivacaine: better anaesthesia without prolonging recovery. Anesth Analg 1997;85:560-5.
11. David BB, Frankel R, Arzumonov T, Marchevsky Y, Volpin G.Minidosebupicvacaine fentanyl spinal anesthesia for surgical repair of hip fracture in the aged. Anesthesiology 2000;92(1):6-10.
12. Varrassi G, Celleno D, Capogna G, Costantino P, Emanuelli M, Sebastiani M et al. Ventilatory effects of subarachnoid fentanyl in the elderly. Anaesthesia 1992;47(7):558-62.
13. Roofthooft E, Van de Velde M. Low-dose spinal anaesthesia for Caesarea section to prevent spinal-induced hypotension. Curr Opin Anaesthesiol 2008;21(3):259-62.
14. Singh H, Yang J. Intrathecal fentanyl prolongs sensory bupivacaine block. Cand J Anaesth 1995;42(11):987-91.
15. Liu S, Chiu AA, Carpenter RL,Mulroy MF, Allen HW, Neal JM et al. Fentanyl prolongs lidocaine spinal anaesthesia without prolonging recovery. AnesthAnalg 1995;80(4):730-4.
16. Sivaram A, Govardhani Y, Varaprasad USSA. A comparative study of low dose Bupivacaine vs high dose Bupivacaine along with Fentanyl and Phenylephrine on Pregnant women undergoing elective Caesarean Section under Spinal Anesthesia. Int J Med Res Rev 2014;2(2):124-9.
17. Leighton BL, DeSimone C, Norris MC, David BB. Intrathecal Narcotics for labor revisited: The combination of Fentanyl and Morphine Intrathecally provides rapid onset of profound, prolonged analgesia. Anaesthesia Analgesia 1989;69:122-5.
18. Diaz M and Becker DE. Thermoregulation: Physiological and Clinical Considerations during Sedation and General Anesthesia. Anesth Prog 2010;57(1):25–33.
19. Chaudhary K, Saxena KN, Taneja B, Gaba P, and Anand R. Intrathecal catheterisation for accidental dural puncture: A successful strategy for reducing post-dural puncture headache. Indian J Anaesth 2014;58(4):473–5.