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Comparison of Intrathecal Hyperbaric Bupivacaine Alone and Hyperbaric Bupivacaine with Fentanyl in Lower Limb Surgery

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ABSTRACT

Introduction: Subarachnoid block is the preferred anaesthetic technique used for lower limb surgeries because of its rapid and profound sensory and motor blockade. Opioids are widely used in conjunction with local anaesthetics in neuraxial blocks for their property of improving the quality and prolonging the duration of local anaesthetics for surgical anaesthesia, as well as post-operative analgesia.

Objectives: Objective of this study was to compare the duration of two segment regression, motor blockade and sensory analgesia, with intrathecal hyperbaric Bupivacaine alone and with Fentanyl added.

Method: In this study, 80 patients above 15 years with ASA (American Society of Anaesthesiologist) physical status I and II, undergoing subarachnoid block for various lower limb surgeries were studied in a double-blinded, randomized prospective manner. Patients were divided into two equal groups - Group B (n= 40) received hyperbaric bupivacaine 15 mcg, and Group BF received hyperbaric bupivacaine 12.5 mg with fentanyl 25 mcg, making a total volume of 3 ml in both the groups. Patients were compared intraoperatively and postoperatively for the duration of motor blockade, time for two segment regression and duration of sensory analgesia and complications.

Results: The time for two segment regressions, time for sensory analgesia, duration of motor blockade, was significantly higher in group BF i.e., 119 ±19 mins, 310 ±20 mins and 236±17 mins respectively, as compared to group B i.e., 83 ±20, 223 ± 22, 186 ±19 minutes respectively. Both the groups were comparable with demographic profile and hemodynamic parameters.

Conclusion: The addition of fentanyl 25 mcg prolongs the time for two segment regression and duration of sensory analgesia for lower limb surgeries.

Key words: Bupivacaine; fentanyl; hyperbaric; intrathecal.

INTRODUCTION

Subarachnoid block provides a quick and profound sensory, motor block. It was firstly performed by August Bier on August 16, 1898 at Royal Surgical Hospital of the University of Kiel, Germany.[1] Study shows adjuvants (clonidine[2], neostigmine[3], ketamine[4], midazolam[5] and opioids[6]) enhances the quality, duration, post-operative analgesia, minimize dose anaesthetics. Opioids (fentanyl, sufentanil

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and morphine) as adjuvants provide better intraoperative and post-operative analgesia due to their potent synergistic analgesic effect.[7,8,9] Intrathecal opioids produce synergistic analgesic effect enhancing the sensory blockade without altering the degree of sympathetic blockade ensuring better hemodynamics.[10]

Local anaesthetics act by blockade of voltage gated sodium channels in axonal membrane, inhibiting the presynaptic calcium channel.[11]Intrathecally, opioid act on the opioid receptors in brain and spinal cord to produce analgesia. A small number of opioids diffuse into epidural space with subsequent systemic absorption resulting in centrally mediated analgesia.[12] The successful use of intrathecal morphine first described by Wang et al[13] in 1979. Neuraxial administration of opioid improved the quality of perioperative analgesia. Morphine being a hydrophilic agent may not be the optimal opioid, with slow onset of action and possibility of delayed respiratory depression. Fentanyl on the other hand is lipophilic with rapid onset of action. Fentanyl not only improves the quality of analgesia but also reduces the need of supplemental sedation.

Objective of this study was to compare the duration of two segment regression, motor blockade and sensory analgesia, with intrathecal hyperbaric Bupivacaine alone and with Fentanyl added.

METHODS

After getting ethical approval from Institution Review Committee of Universal Medical College, 80 patients with ASA physical status I and II, aged 15 years and above, undergoing lower limb surgical procedures were selected from January to December 2016. Patients who were contraindicated to sub arachnoid blocks, hypersensitivity to local anaesthetics, patients requiring general anaesthesia or failed SAB (sub arachnoid block) were excluded from the study. They were then randomly allocated to one of the two groups using a sealed envelope technique. Group B received 3 ml of 0.5% heavy Bupivacaine (15 mg). Group BF, received 2.5 ml of 0.5% heavy Bupivacaine (12.5 mg) + 0.5 ml of Fentanyl 25mcg making it a total of 3ml of volume.

Preoperative evaluation was done a day prior to surgery. Patient were kept nil per oral 6 hours prior to surgery. Patients were pre medicated with oral Diazepam (5mg) at bed time. On the day of surgery, in the pre-anaesthetic preparation room, baseline blood pressure, heart rate and oxygen saturation were recorded. Intravenous cannulation was done with 18 G cannula and the patients were preloaded with Ringer lactate solution, 10 ml/kg within 30 mins. Patients were kept in sitting position for subarachnoid block. The assigned drugs were administered to the patients via subarachnoid block with strict aseptic precautions in sitting position via midline/ para median approach in

the L3-L4 intervertebral space using 25G Quincke's needle. After establishing a free flow of clear cerebrospinal fluid, 3 ml of study drug was administered intrathecally. The patient was then immediately turned supine. Monitoring of heart rate, blood pressure (systolic, diastolic, mean blood pressure) and saturation was done as per ASA standard monitoring requirement and the readings were recorded every 5 minutes for the first 30 mins and at every 30 mins interval for the next 2 hours.

Sensory level of block was assessed by loss of sharp sensation to pinprick bilaterally in the mid clavicular line at 5 mins after the study drug was given and then at 10, 20, 30 mins respectively, and at the end of operation and thereafter at 30 mins interval until two segment regressions occurred. Surgical procedure was allowed to start only after the level of block reached T10 dermatome level. If the sensory block level did not reach up to this level in 30 mins, then patient was excluded from the study. Motor block was assessed using modified Bromage[14] scale. It was assessed at 5, 10, 20, 30 mins interval respectively, and at 30 minutes' interval thereafter until full recovery of power occurred.

Bromage[14] score was described as:

Grade I- free movement of legs and feet i.e., nil block

Grade II- just able to flex knees with free movement of feet i.e., partial block,

Grade III- unable to flex knees, but with free movement of feet i.e., almost complete block; and

Grade IV- unable to move legs or feet i.e., complete block.

Complications were noted and managed accordingly. Hypotension, fall in systolic pressure by more than 20% from the baseline value, was managed by intravenous Mephentermin 6 mg. Bradycardia, defined as heart rate less than 40/min, was managed by intravenous Atropine 0.6 mg.

Nausea and vomiting were graded as:

Grade 0: No nausea,

Grade 1: Mildly nauseated, not requesting for treatment,

Grade 2: Severe nausea requesting for treatment

Grade 3: Vomiting

Intravenous Ondansetron (4 mg) was given for nausea and vomiting grade more than or equal to 2. If Respiratory depression (respiratory rate less than 10 breaths/min) occurred leading to fall in saturation <90%, oxygen supplementation was done via face mask at 5 litres/minute.

Pruritus was graded as:

0: no itching,

grade 1: mild itching not requiring treatment,

grade 2: moderate itching requiring first line of treatment,

grade 3: severe itching requiring second line of treatment.

Intravenous Promethazine 12.5 (mg) was given for pruritis grade more than 2 as the first line treatment. If the symptoms did not improve in next 10 mins, then Inj. naloxone 0.01ml/kg i.v was given as the second line. Any other complication was also noted.

After the completion of the surgical procedure, the patient was shifted to the recovery room and monitored till motor block fully recovered then only the patient was transferred. Duration of analgesia was defined as the time interval from injection of spinal anaesthesia to the request of first dose of analgesic. When patient complained of pain, intravenous Ketorolac (30 mg) and intravenous paracetamol (1 gm) were given.

Analysis was performed using SPSS version 20, to test the significance of sample, chi-square test had been conducted where the results were deemed significant if the *P* value was equal to or less than 0.05.

RESULT

The two groups [group B (bupivacaine), group BF (bupivacaine with Fentanyl)] were well matched for age and statistically no difference was seen in hemodynamic parameters. Statistically significant difference was seen in two segment regression, duration of motor blockade, and duration of sensory analgesia.

Table 1: Sample size distribution based on sex and groups.

Group	Male (%)	Female (%)
Bupivacaine (B)	48(n=23)	53(n=17)
Bupivacaine with Fentanyl (BF)	52(n=25)	47(n=15)
Total	100	100

Table 2: Baseline intraoperative hemodynamic.

Parameters	B	BF	*P* Value
Baseline heart rate	85 (±18)	83 (±15)	0.52
Intraoperative heart rate	79 (±16)	79 (±15)	0.568
Baseline Mean SBP	128 (±16)	137 (±20)	0.201
Intraoperative SBP	109 (± 16)	113 (± 12)	0.460
Baseline Mean DBP	86 (±14)	87 (±20)	0.398
Intraoperative Mean DBP	70 (±13)	69 (±9)	0.410
Baseline Mean MAP	97 (±12)	99(±14)	0.256
Intraoperative Mean MAP	81 (±13)	81 (± 9)	0.489

*SBP= systolic blood pressure, DBP = diastolic blood pressure, MAP = mean arterial pressure

Table 3: Duration for two segment regressions.

Group	Maximum (mins)	Minimum (mins)	Mean (mins)	Standard deviation
B	120	60	83	± 20
BF	150	90	119	± 19

P value:0.000

Table 4: Duration of Motor Block

Group	Maximum (mins)	Minimum (mins)	Mean (mins)	Standard Deviation
B	240	150	186	± 19
BF	270	210	236	± 17

P value: 0.000

Table 5: Duration of sensory analgesia.

Groups	Maximum (mins)	Minimum (mins)	Mean (mins)	Standard Deviation
B	272	180	223	± 22
BF	365	275	310	± 20

P value: 0.008

DISCUSSION

The discovery of opioid receptor and subsequent development of intrathecal opioid administration has gained widespread popularity and significant advancement in better analgesic management for decades now. Different studies have shown the effect of the spinal anaesthesia is potentiated by intrathecal opioids.[6,7,9,10,15]

The recommended level of regional anaesthesia for lower limb surgery is T10.[16] Here in our study we have used bupivacaine 12.5 mg and 15 mg, as it is the standard recommended dose for using hyperbaric bupivacaine 0.5%.[16] Among the opioids, we chose fentanyl with dose of 25 mcg, as it has been seen that this dose provides maximum duration of post-operative analgesia with minimal side effects like respiratory depression and pruritus.[17]

In our study the time for two segment regression was statistically significant between the two groups (p= <0.0001). The mean time for the two segments regression for group B was 83 ± 20 mins while in group BF it was 119 ± 19 mins. It indicates that adding fentanyl prolongs duration of sensory block due to binding to opioid

receptor. In the study done by Makwana et al,[7] the regression of sensory level to T12 was highly significant for group with bupivacaine (165.98 mins ±25.07) compared to the group with bupivacaine with fentanyl (192 mins ±29.05) in sixty patients of gynaecological surgery. Similar results were found in studies done by Harbhej Singh et al[18], Chandra et al[19], Khanna et al[20], S Liu et al.[21]

The duration of sensory analgesia, described as the time interval from injection of spinal anaesthesia to the request of first dose of analgesic was significantly more (p=0.008) in group BF than in group B (310 ± 20 mins vs. 223 ± 22 mins respectively). This indicated that there was decreased analgesic requirement in the early postoperative period in fentanyl added group. It was in concordance to the study done by, Makawana et al[7] which showed that the duration of sensory analgesia was significant with group having bupivacaine and fentanyl combination compared to bupivacaine alone with 310.44 mins ±41.532 and 213.20 mins ±21.46 respectively. Similar results were also noted from studies done by, Harbej Singh et al[18], Ben david et al[22] and Karakan M, Tahaci N,Göksu S.[23]

In our study motor block is significantly prolonged in fentanyl group than in bupivacaine alone group. In the study done by Vaghadia et al[24] a small dose lidocaine- fentanyl spinal anaesthesia had advantages over conventional dose lidocaine, including less hypotension and faster motor and sensory recovery. There were no statistically significant differences in hemodynamic parameters in the two groups. It was observed that addition of 25 mcg of fentanyl does not have any significant effect on patient's hemodynamic status; which was similar to the study of Chandra et al.[19]

Further study should be done on the optimal doses and dilutions (and diluents) of intrathecal combinations of bupivacaine and fentanyl.

CONCLUSION

The addition of fentanyl to hyperbaric bupivacaine 0.5% will increase the duration of sensory analgesia making it suitable for providing a better pain relief and decreased demand of analgesic in immediate postoperative period. Further adding fentanyl to hyperbaric bupivacaine 0.5% with lesser dose can provide a stable hemodynamic as compared to hyperbaric bupivacaine 0.5% alone. Though both were found to be non-significant from our study.

Conflict Of Interest: None.

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