Original Research Article

Indian Journal of Anesthesia and Analgesia
2019; 6(5) (Part - II): 1779-1783
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6519.41

Comparison of Dexmedetomidine and Buprenorphine as an Adjuvant to Bupivacaine in Spinal Anesthesia for Femur Interlocking Surgeries

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Abstract

Background: Spinal anesthesia with bupivacaine is administered routinely for lower limb surgeries along with additives for better hemodynamics, prolonged sensory and motor blockade. Most commonly used additives being opiods. In the present study non-opiod like dexmedetomidine is compared with buprenorphine as an adjuvant for bupivacaine in patients undergoing femur interlocking nailing surgeries. *Materials and Methods:* In the present randomized controlled prospective double-blinded study a total of 90 patients from either gender, aged 20–60 years of ASA I and II undergoing femur interlocking nailing surgeries under spinal anesthesia were included. The patients were randomly divided into two groups (n = 45 each) by closed envelope technique. Patients in Group B received 15 mg of 0.5% hyperbaric bupivacaine with 45 µg of buprenorphine, and Group D received 15 mg of 0.5% hyperbaric bupivacaine with 5 µg dexmedetomidine for spinal anesthesia. The duration of motor and sensory blockade, time to first analgesic requirement and any adverse events were recorded. Data were analyzed using Fisher's exact test or Chi-square test for categorical data and analysis of variance for continuous data. The value of $p < 0.05$ was considered statistically significant. *Results:* In our study the subjects in Group D (dexmedetomidine) group had significantly longer period of motor blockade (190 ± 18.2 min) and sensory blockade (145 ± 20.2 min) compared to Group B (120 ± 17.2, 102 ± 13.5) respectively, which is statistically significant ($p < 0.05$ and $p < 0.05$* respectively). The time to first request of analgesic in the postoperative period was also longer (200 ± 21.9 min) in dexmedetomidine group when compared with Group B (130 ± 20), ($p < 0.05$*). There were no untoward complications (hypotension, sedation) in any groups. *Conclusion:* Intrathecal dexmedetomidine (5 µg) with bupivacaine for spinal anesthesia gives significantly longer duration of sensory and motor blockade than intrathecal buprenorphine (45 µg) with bupivacaine for spinal anesthesia.

Keywords: Dexmedetomidine; Buprenorphine; Femurinterlocking; Spinal anesthesia; Bupivacaine.

How to cite this article:

Pradeep R, Dhananjeyulu P. Comparison of Dexmedetomidine and Buprenorphine as an Adjuvant to Bupivacaine in Spinal Anesthesia for Femur Interlocking Surgeries. Indian J Anesth Analg. 2019;6(5 P-II):1779-1783.

Introduction

Subarachnoid block is the regional anesthesia technique of choice for lower limb surgeries,[1,2] as it has advantages like, preserving consciousness, maintains spontaneous breathing and provides adequate analgesia and muscle relaxation.

Local anesthetics in combination with adjuvants like fentanyl, buprenorphine are being used in sub arachnoid blocks since long as they shorten

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Received on 24.06.2019, **Accepted on** 16.08.2019

the onset of action, increase the quality of block, increase the duration of anesthesia and analgesia, and decrease the dose of local anesthetics.[2–4]

Dexmedetomidine, when used in subarachnoid block the analgesic effect is mediated via spinal α2 receptors by inhibiting the C-fiber neurotransmitter release and hyperpolarization of postsynaptical neuron.[5] Motor blockade duration is increased when dexmedetomidine binds with motor neurons in spinal cord.[6–9]

Prolonged analgesic property of buprenorphine is because of its action at both spinal and supraspinal levels.[4,10]

The main purpose of this study is to evaluate and compare the efficacy of dexmedetomidine 5 μg and buprenorphine 45 μg when used as an additive to 0.5% hyperbaric bupivacaine for spinal anesthesia.

Materials and Methods

The present study was conducted after taking informed written consent from participating patients. In the present prospective randomised controlled double blinded study, 90 patients of either gender in the 20–60 age group years, of American Society of Anesthesiologists (ASA) 1 and 2 undergoing femoral interlocking nailing surgeries were included. Patients with neurological, respiratory, cardiac, renal diseases, bleeding disorders, known hypersensitivity to local anesthetics, infection at lumbar spine were excluded from the study.

Patients were randomly assigned into two groups by a sealed envelope technique. Group B and group D of 45 each and the study drug is given as below.

Group B: 45 μg of buprenorphine with 15 mg of 0.5% hyperbaric bupivacaine.

Group D: 5 μg of dexmedetomidine with 15 mg of 0.5% hyperbaric bupivacaine.

Standard monitoring included ECG (Electrocardiogram), pulse oximetry, and NIBP (Non-invasive blood pressure). Ambient temperature was noted. Baseline vital parameters were recorded. IV access was obtained with 18G canula and IV fluids started.

Under aseptic precautions spinal injection of 15 mg of 0.5% hyperbaric bupivacaine with the study drugs (Buprenorphine and Dexmedetomidine) in the respective groups were given intrathecally in L_3-L_4 interspace using 25 G spinal (Quincke) needle in sitting position after confirming subarachnoid space with free flow of clear cerebrospinal fluid, and patients were made to lie in supine position immediately after the procedure.

Patients demographic data like age (years), sex, weight (kilograms), height (centimeters) and ASA physical status were noted. Vital parameters like heart rate, mean arterial pressure (non-invasive) were recorded every 5 minutes for first 30 minutes and every 15 minutes till the end of surgery. Bradycardia (HR <45) is treated with atropine 0.6 mg and hypotension (mean arterial pressure <65 mm hg) treated with injection mephentermine 6 mg IV bolus. Total number of patients requiring atropine or mephentermine were noted. After the surgery patients were shifted to postoperative ward.

Level of sensory block was tested using pinprick technique until thoracic (T10) level was achieved. Time taken for regression of sensory block to sacral (S1) were recorded.

Modified bromage (MB) scale has been used to assess the motor block.[11] Time taken to reach MB score 3 was noted.

Score 0: Full leg movement, full flexion of knees and ankle.

Score 1: Inability to raise extended legs, just able to flex knees, full ankle flexion.

Score 2: Inability to flex knees, some flexion of ankles possible.

Score 3: Unable to move legs or feet.

Time taken for motor block to regress to MB score 0 was assessed and noted.

Ramsay sedation scale was used to assess the sedation levels:[13]

Scale 1 — anxious, restless

Scale 2 — cooperative, oriented, tranquil

Scale 3 — responding to commands

Scale 4 — brisk response to stimulus

Scale 5 — sluggish response to stimulus

Scale 6 — no response to stimulus.

The level of pain was assessed at 1,6,12,18 and at 24 hours postoperatively, based on visual analogue score (VAS)[14], where 0 = no pain and 10 = severe pain. Time to first rescue analgesia was noted when VAS score was 4 and above. Number of patients requiring rescue analgesia (injtramadol 100 mg IV) for 24 hours were noted. Patients were monitored for any side effects postoperatively (sedation, hypotension, pruritus).

Statistical analysis

Descriptive statistical analysis was represented as Mean ± SD and results on categorical measurements are represented as percentages. Appropriate tests of significance like the independent *t*-test and chi-square test were used depending on nature and distribution of variables. Values of $p < 0.05$ were considered significant.

Results

There were no significant difference observed with respect to patients demographic data, ASA status and duration of surgery among the two groups (Table 1).

Table 1: Patient Characteristics

Variables	Group B	Group D
Age (years)	44.5 ± 10	41 ± 15
Height (centimeters)	160 ± 5	158 ± 4
Weight (kilograms)	65.4 ± 4	66 ± 6
Gender (male/female)	25/20	23/22
ASA grade (1/2)	38/7	36/9
Duration of surgery (minutes)	90 ± 10	94 ± 09

Data presented as mean ± standard deviation.

Among the spinal block characteristics (Table 2), time to regress to sensory level S1 was longer in Group D (145 ± 20.2) when compared to Group B (102 ± 13.5) which is statistically highly significant ($p < 0.05$). The time to motor block regression to modified bromage 0 was significantly ($p < 0.05$) longer in Group D (190 ± 18.2) when compared to Group B (120 ± 17.2). The time to first request for analgesia was longer in Group D (200 ± 21.9) than Group B (130 ± 20).

Table 2: Showing Spinal Block Characteristics in Patients

Variable	Group B	Group D	*p* value
Time to reach highest sensory block, T4 (min)	11 ± 5	15 ± 4	0.144
Sensory block-time to regression to S1 (min)	102 ± 13.5	145 ± 20.2	<0.05*
Motor block-time to reach modified bromage 3 (min)	8 ± 1.4	10 ± 1.2	0.7
Motor block regression to modified bromage 0 (min)	120 ± 17.2	190 ± 18.2	<0.05*
Time for 1st analgesia (min)	130 ± 20	200 ± 21.9	<0.05*

Data were expressed as mean ± standard deviation, median and range, min: minutes, TFA: Time to first request of postoperative analgesic, T: thoracic, S: sacral, *p value < 0.05 is statistically significant.

Hemodynamic parameters were stable in both groups and there were no complications in both the groups. No statistically significant differences were noted between the study groups with respect to number of patients who required atropine, mephentermine and tramadol in 24 hours (Table 3).

Table 3: Number of Patients Requiring Atropine or Mephentermine, and any Complications Present

Variable	Group D	Group B	*p* value
Patient requiring atropine (%)	2 (4.4)	3 (6.6)	0.266
Patient requiring mephentermine	3 (6.6)	3 (6.6)	1
Patient requiring tramadol 1 mg/kg	17 (37.7)	16 (35.5)	0.173
Hypotension (%)	7 (15.5)	8 (17.7)	0.266
Sedation	0	0	0
Pruritis	0	0	0

Data presented as mean ± standard deviation; mg: milligram; kg: kilogram; *p values <0.05 statistically significant.

The VAS score was higher in Group B when compared with Group D at any time interval, but statistically non-significant (Table 4).

Table 4: Showing Postoperative Visual Analogue Scale

Variables	Group D	Group B	*p* value
1 hr	0	0	0.0
6 hr	4	3	0.219
12 hr	5	5	1
18 hr	5	5	1
24 hr	4	5	0.202

Data presented as mode, hr: hour, *p value <0.05 is statistically significant.

Discussion

This study was done to compare the addition of buprenorphine 45 µg and dexmedetomidine 5 µg to 15 mg of 0.5% hyperbaric bupivacaine for patients undergoing femur interlocking nailing surgeries under spinal anesthesia.

Dexmedetomidine, a clonidine group of drug having properties of alpha-2 adrenoreceptor agonists, has been recently introduced. It is known for its sedative and anxiolytic effects by acting at the locus ceruleus in the brain stem. Dexmedetomidine, stimulates alpha-2 receptors in the spinal cord acting in the dorsal horn and reduces the sympathetic discharge, similarly it will regulate release of substance P and hence causes hyperpolarization of dorsal horn neurons.[11–15]

Buprenorphine, an opiod acts by partially

inhibiting delta opiod receptors at the same time stimulating kappa and mu receptors. It provides analgesia by acting at both supraspinal and spinal component.[10]

In this study patient characteristics like age, weight, height, ASA physical status are matched. There were no statistical difference noted with reference to hemodynamic parameters like heart rate and blood pressure and no significant side effects like sedation, pruritus, hypotension were seen among the groups.

Kanazi GE in his study showed that there was rapid onset of motor block with prolonged duration of motor and sensory block, when he used 3 μg dexmedetomidine as an adjuvant to intrathecal bupivacaine for spinal anesthesia.[11]

The study done by Vidhi Mahendru *et al.*[1], it was shown that there was prolonged duration of sensory and motor block with preserved hemodynamics and decreased postoperative analgesic requirement when he used dexmedetomidine 5 μg with 12 .5 mg bupivacaine for spinal anesthesia, and compared with clonidine 30 μg, fentanyl 25 μg, or 12.5 mg plain bupivacaine alone in patient undergoing spinal anesthesia.

In our study when dexmedetomidine 5 μg when added to intrathecal 15 mg of 0.5% bupivacaine significantly prolonged the time of regression for the sensory level to S1 level (<0.05*) when compared to Group B. It also showed that motor regression to modified bromage 3 and time to request for first analgesia was longer in dexmedetomidine group and was statistically significant when compared to Group B (<0.05).

Conclusion

Dexmedetomidine 5 μg when added to 15 mg of 0.5% heavy bupivacaine for spinal anesthesia in patients undergoing femur interlocking nailing provides longer duration of sensory and motor blockade when compared to that of buprenorphine 45 μg when added to 15 mg of 0.5% heavy bupivacaine for spinal anesthesia.

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