

## Original Research Article

# Comparison of dexmedetomidine and buprenorphine as an adjuvant to bupivacaine during spinal anaesthesia for tibial interlocking nailing surgeries

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### ABSTRACT

**Background:** Buprenorphine is being used as an adjuvant to local anaesthetic for spinal anaesthesia since long. Dexmedetomidine is a new drug which has got alpha 2 agonistic property, and is being tried for spinal anaesthesia along with bupivacaine in recent times. **Settings and Design:** This study was conducted in a prospective, randomized, controlled and double-blind manner. The study included ninety American Society of Anaesthesiologists class I and II patients undergoing tibial interlocking nailing surgeries under spinal anaesthesia.

**Methods:** The patients were randomly divided into three groups (n=30 each) by closed envelope technique. Patients in group 1 received 15 mg of 0.5% hyperbaric bupivacaine, group 2 received 15 mg of 0.5% hyperbaric bupivacaine with 30µg of buprenorphine, and group 3 received 15 mg of 0.5% hyperbaric bupivacaine with 5µg dexmedetomidine for spinal anaesthesia. The duration of motor and sensory blockade and any adverse events were recorded. Data were analysed using Chi-square test or Fisher's exact test for categorical data and analysis of variance for continuous data. A value of P<0.05 was considered as statistically significant.

**Results:** In our study the subjects in group 3 (dexmedetomidine) group had significantly longer period of motor blockade (240±20min) and sensory blockade (180±22.2min) compared to other groups, which is statistically significant (P=0.0001 and P= 0.006 respectively). The time to first request of analgesic in the post-operative period was also longer (240±30.2min) in dexmedetomidine group when compared with other groups (P=0.0001). There were no untoward complications (hypotension, sedation) in any groups.

**Conclusions:** We concluded that dexmedetomidine (5µg) with bupivacaine for spinal anaesthesia gives significantly longer duration of sensory and motor blockade, than buprenorphine (30µg) with bupivacaine for spinal anaesthesia.

**Keywords:** α2-adrenoreceptor agonist, Bupivacaine, Buprenorphine

### INTRODUCTION

Spinal anaesthesia is the choice of regional anaesthesia technique for surgeries on the lower limbs, as it preserves consciousness, spontaneous breathing at the same time provides for analgesia and muscle relaxation.<sup>1,2</sup> These advantages can be minimized when local anaesthetic

alone is used for spinal anaesthesia, as it provides for shorter duration of action.<sup>2,3</sup> Many adjuvants like fentanyl, buprenorphine have been tried and are effective to prolong the anaesthetic effects.<sup>2,4</sup> Dexmedetomidine, is a selective alpha2-adrenoreceptor agonist has been used for analgesia and intravenous sedation in intensive care unit.<sup>5,6</sup> When used for spinal anaesthesia, it acts on the

alpha 2 receptors on the dorsal horn cells and reduces the sympathetic neurotransmitter release. The duration of motor block may be increased when it binds to the motor neurons in the spinal cord.<sup>7-10</sup>

In our study we have evaluated the effects of adding dexmedetomidine and buprenorphine to hyperbaric bupivacaine separately for spinal anaesthesia.

## METHODS

Ninety patients (male or female), who are in the age group between 20-50years, belonging to American Society of Anaesthesiologists (ASA) class I and II, scheduled for tibial interlocking nailing surgery under subarachnoid block at P.E.S. Institute of Medical Sciences, Kuppam, were enrolled in this prospective, randomized, controlled and double blinded study.

### Exclusion criteria

Patients with contraindications to spinal anaesthesia, ischemic heart disease, heart blocks, hypertension, renal disorders, and liver disorders, pregnant patients, were excluded from the study.

The anaesthesia technique, the visual analogue scale (VAS) for pain and other things were explained to the patients in the pre-operative room and informed written consent was taken. In the operation theatre, an 18Gauge intravenous cannula was inserted in the hand, preloaded with 10ml/kg Ringer's lactate solution. Electrocardiogram, pulse oximeter, non-invasive arterial pressure monitor was applied. Patients were randomly grouped (by closed envelope technique) into three equal groups (n=30 each). The blind nature of the study was maintained, and the study drug is given accordingly as below.

- Group 1: 15mg of 0.5% hyperbaric bupivacaine.
- Group 2: 15 mg of 0.5% hyperbaric bupivacaine plus 30µg of buprenorphine.
- Group 3: 15 mg of 0.5% hyperbaric bupivacaine plus 5µg of dexmedetomidine for spinal anaesthesia.

Lumbar puncture was done under aseptic precaution in the sitting position as follows. Local anaesthetic was infiltrated, a 25G Quincke type spinal needle was inserted at L3-L4 space, the study drug is injected after confirming free flow of cerebro-spinal fluid, after the procedure the subjects were put in the supine position. Oxygen 5L/min by face mask was given to all the patients. After the surgery, all the patients were shifted to the postoperative room, where the patients were monitored and discharged to the ward after spinal block effect faded.

The demographic data of the patients: age (in years), sex, weight (in kilograms), height (in centimeters) and ASA physical status were noted. Hemodynamic parameters:

heart rate, mean arterial pressure were recorded before the block. After the block was performed, the mean arterial pressure and heart rate were recorded every 5minutes for the first 30minutes and then every 10minutes intraoperatively till the patient is shifted from the recovery room. Hypotension was said to have occurred when systolic blood pressure decreased by more than 20% from baseline measurement or a fall below 90mmHg, it was treated with bolus intravenous infusion of normal saline 300ml and incremental doses of intravenous mephentermine 5mg as required. Bradycardia was said to have occurred if heart rate  $\leq 50$ beats/min, it was treated with 0.6mg of intravenous atropine. Total number of patients who required atropine or vasopressor (mephentermine) in the intra-operative period were recorded.

Sensory block levels were tested by pinprick test every minute for the first 10 min or until T10 level was obtained. Time for regression of sensory blockade to S1 level were recorded.

The motor block was assessed and recorded using modified Bromage Scale, and time to reach modified Bromage (MB) score 3 was recorded.<sup>11,12</sup>

- MB Score 0=the subject is able to move the hip, knee and the ankle;
- MB Score 1= the subject is unable to move the hip, but not knee and ankle;
- MB Score 2= the subject is unable to move the hip and knee, but not ankle;
- MB Score 3= the subject is unable to move the hip, knee and ankle.

The time to regress of motor blockade to modified Bromage score 0 was assessed and recorded in the post-operative period. Sedation levels were assessed using Ramsay sedation score<sup>13</sup>:

- Score 1=patient is anxious, agitated;
- Score 2=patient is cooperative, oriented;
- Score 3=patient drowsy but responds to commands;
- Score 4= asleep, but with brisk response to glabellar tap or tactile stimulation;
- Score 5=asleep with a sluggish response to light glabellar tap or tactile stimulation and
- Score 6= asleep and no response.

The postoperative pain scores were recorded for 24 hours at 1, 6, 12, 18, and 24 hours using Visual analogue scale (VAS).<sup>14</sup> The time to first request for analgesia was recorded.

Number of patients who required rescue postoperative analgesia (Tramadol hydrochloride 1mg/kg in-travenous) in 24hours were noted. Postoperative complications like sedation, hyperglycemia, hypotension, pruritus if present were noted.

**Statistical analysis**

SPSS 15 was used for statistical analysis. Pilot study done showed that for 30minutes increase in the duration of sensory blockade among the groups required 30 patients per group such that the alpha error will be 0.05 and power will be 0.8. Data were given as means and standard deviation (SD), medians and ranges. Chi-square and fisher exact tests were used for categorical data like (sex, ASA class, nausea/ vomiting, use of additive

analgesia, hypotension, and bradycardia). ANOVA test was used for continuous data like (age, duration of surgery). P value<0.05 is taken as significant in the limit of 95% confidence interval.

**RESULTS**

There was no significant difference observed with respect to patient’s demographic data, ASA status and duration of surgery among the three groups (Table1).

**Table 1: Patient characteristics and other data in the studied groups.**

Variables	Group 1	Group 2	Group 3	P value
Age (years)	44.6+/-12	41.2+/-15	44+/-12	0.946
Height (centimeters)	155+/-3	156+/-3.3	156+/-4	0.997
Weight (kilograms)	64.5+/-10.2	62+/-10	60.5+/-8	0.961
Gender (male/Female)	20/10	19/11	18/12	0.968
Asa grade (1/2) n	24/6	22/8	21/9	0.942
Duration of surgery (minutes)	92+/-10	96 +/-12	98+/-8	0.910

Data presented as mean ±standard deviation

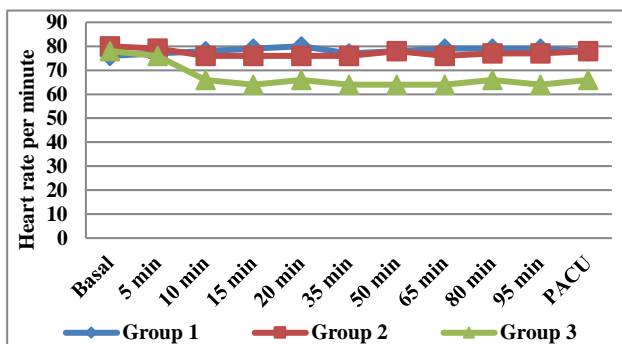
Among the spinal block characteristics (Table 2), the time to regress sensory block level to S1 was longer in group 3 (180±22.2min) when compare with group 1 (105±14.5min) and group 2 (150±20.2min) which is statistically highly significant (P=0.006). The time to

motor block regression to modified Bromage 0 was significantly (P=0.0001) longer in group 3 (240±20 min) when compare with group I (120±18.2min) and group 2 (198.2±18.4min). The time to first request for analgesia was longer in group 3 (240±30.2min) than group 1 and group 2 (130±20 and 210±22.4 respectively).

**Table 2: Showing spinal block characteristics of patients in three groups.**

Variable	Group 1	Group 2	Group 3	P value
Time to reach highest sensory block level (min)	12+/-5	16+/-4	9+/-4	0.494
Sensory block- time to regression to S <sub>1</sub> (min)	105+/-14.5	150+/-20.2	180+/-22.2	0.006*
Motor block- time to reach modified bromage 3 (min)	7.0+/-1.6	9+/-1.4	5.0+/-1.4	0.628
Motor block regression to modified bromage 0 (min)	120+/-18.2	198.2+/-18.4	240+/-20	0.0001*
TFA (min)	130+/-20	210+/-22.4	240+/-30.2	0.0001*

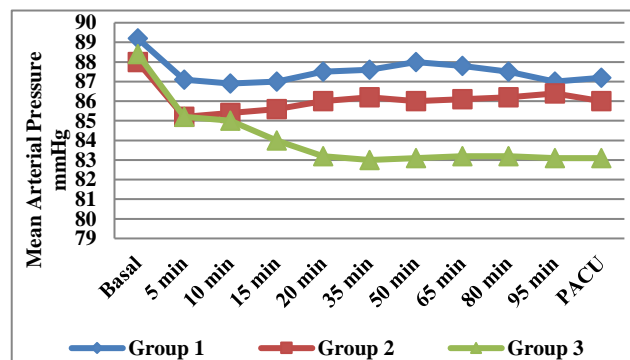
Data were expressed as mean ±standard deviation, median and range, min: minutes, TFA: Time to first request of postoperative analgesic, T: thoracic, S: sacral, \*P values <0.05 is statistically significant.



**Figure 1: Heart rate variations in three groups.**

There is no statistically significant variation in heart rate of patients in 3 groups (P>0.05) (Figure 1). With regards to intra-operative mean arterial blood pressure, the study

groups showed no significant differences (P>0.05) (Figure 2).



**Figure 2: Mean arterial pressure difference in three groups.**

Hemodynamic parameters were stable in all the groups and there were no complications in any patient among the three groups. No statistically significant differences

among the study groups in the number of patients who required atropine, ephedrine, and tramadol in 24 hours were seen (Table 3).

**Table 3: Number of patients required atropine or mephentermine, and complications.**

Variable	Group 1	Group 2	Group 3	P value
Patient required atropine (%)	2(7%)	3(10%)	3(10%)	0.807
Patient required ephedrine (%)	2(7%)	3(10%)	3(10%)	0.890
Patient required tramadol 1mg/kg intravenous in 24h (%)	18(60%)	17(57%)	16(52%)	0.963
Hypotension (%)	5(17%)	4(12%)	4(12%)	0.935
Sedation	0	0	0	0
Pruritus	0	0	0	0

Data presented as mean  $\pm$  standard deviation, h: hours, mg: milligram, kg: kilogram, \*P values <0.05 statistically significant.

The VAS score was higher in group 1 and lower in group 3 at any time interval, but which statistically non-significant (Table 4).

**Table 4: Postoperative visual analogue scale.**

Variables	Group 1	Group 2	Group 3	P value
1 h	0	0	0	0.0
6 h	5	3	3	0.425
12 h	6	5	3	0.644
18 h	5	5	3	0.760
24 h	5	4	2	0.561

Data presented as mode, h: hour, \*P value <0.05 is statistically significant.

## DISCUSSION

In this study we have compared the addition of buprenorphine (30 $\mu$ g) and dexmedetomidine (5 $\mu$ g) to 15mg of 0.5% hyperbaric bupivacaine for spinal anaesthesia separately, in the patients undergoing tibial interlocking nailing surgery. Dexmedetomidine is an alpha 2 adrenoceptor agonist. It produces Sedative and anxiolytic effects by its action on locus ceruleus of the brain stem. Dexmedetomidine, by stimulating alpha 2 receptors at dorsal horn neurons of the spinal cord reduces the sympathetic discharge and also modulates the release of substance P and causes hyper polarization of dorsal horn neurons.<sup>6,15-18</sup>

Buprenorphine is an opioid and it acts by stimulating kappa and mu opioid receptors and partially inhibiting delta opioid receptors. And it has both spinal and supra spinal component of analgesia.<sup>19</sup>

In our study patient's demographic characteristics and the duration of surgery was matched such that they will not influence the result of the study. There were no significant differences with respect to hemodynamic characters (heart rate, Blood pressure) among the groups and also there were no significant side effects (sedation, hypotension etc.) among the groups studied.

Kanazi GE and his co-workers concluded that 3 $\mu$ g dexmedetomidine when added to intrathecal bupivacaine for spinal anaesthesia resulted in rapid onset of motor block, prolonged the duration of motor and sensory block, and there were no hemodynamic derangement and it didn't cause sedation.<sup>6</sup>

Similar to our results, a study by Vidhi Mahendru et al, showed that dexmedetomidine 5 $\mu$ g with 12.5mg bupivacaine prolonged the duration of motor and sensory block, preserved hemodynamics and decreased postoperative analgesic requirement compared to clonidine 30 $\mu$ g, fentanyl 25 $\mu$ g, or 12.5mg hyperbaric bupivacaine alone in patients undergoing lower limb surgery.<sup>1</sup>

In this study the addition of dexmedetomidine 5 $\mu$ g to intrathecal 15mg of 0.5% heavy bupivacaine for spinal anaesthesia significantly prolonged the time for the sensory spinal regression to S1 level (P=0.006) when compared to other groups. Our study showed that motor regression to modified Bromage score 0 and time for request of first analgesia was significantly longer in dexmedetomidine group than other groups (P=0.0001).

## CONCLUSION

Addition of dexmedetomidine (5 $\mu$ g) to 15mg of 0.5% heavy bupivacaine for spinal anaesthesia, provides longer duration of sensory and motor blockade than compared to that of buprenorphine (30 $\mu$ g) to 15mg of 0.5% heavy bupivacaine for spinal anaesthesia.

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