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Comparison of intrathecal dexmedetomidine and buprenorphine as adjuvant to 0.5 % hyperbaric bupivacaine in spinal anaesthesia for orthopaedic surgery

KEYWORDS: bupivacaine, hyperbaric, dexmedetomidine, buprenorphine, orthopaedic, spinal, anesthesia

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ABSTRACT

Aims of Study : The aim of the study was to compare intrathecal dexmedetomidine (Group D) and buprenorphine (Group B) in spinal anaesthesia for orthopaedic surgery in terms of onset and duration of sensory and motor block,haemodynamic parameters,post operative analgesia and side effects,if any.

Methods : *This comparative, randomized ,double blind study was conducted in seventy patients scheduled to undergo elective orthopaedic lower limb surgeries. Group D (n=35) received 15 mg(3 ml) of 0.5% hyperbaric bupivacaine + 5 mcg of dexmedetomidine + Normal saline to make the total volume 3.5 ml while Group B (n=35) received 15 mg(3 ml) of 0.5% hyperbaric bupivacaine + 60 mcg of buprenorphine + Normal saline to make the total volume 3.5 ml. Onset and duration of sensory and motor block, total duration of analgesia,hemodynamic parameters,post operative VAS score, number of rescue analgesics required and adverse effects were noted.*

Results: *There was no significant difference in sensory and motor block onset between 2 groups but significantly prolonged duration of sensory and motor block and post operative duration of analgesia was seen in group D as compared to group B. Significantly reduced number of rescue analgesics were required in group D . Both groups were comparable in terms of hemodynamic parameters and no significant adverse effects were observed in both groups.*

Conclusion : *It was concluded that 5 μg dexmedetomidine as adjuvant to 0.5 % hyperbaric bupivacaine in spinal anesthesia provided prolonged duration of sensory and motor blockade and longer duration of analgesia and stable hemodynamic profile as compared to 60 μg buprenorphine.*

INTRODUCTION

Spinal anesthesia is commonly employed technique for orthopaedic lower limb procedures and provides effective analgesia in early post operative period. Various adjuvants have been added to spinal local anaesthetic to prolong post operative analgesia.[1] Neuraxial adjuvants are utilised to increase the speed of onset of neural blockade (reduce latency), improve the quality and prolong the duration of neural blockade and for their dose sparing effects [1]. Buprenorphine is a mixed agonist – antagonist narcotic with high affinity at both mu (μ) and kappa opiate receptors. Lanz et al [2] demonstrated that buprenorphine is compatible with CSF and has no adverse effecs when administered intrathecally. Intrathecal α2 receptor agonists have antinociceptive action for both somatic and visceral pain [3]. α2 receptor agonists administered intrathecally prolonged the analgesia provided by subtherapeutic doses of local anaesthetics like bupivacaine due to synergistic effects with minimal haemodynamic effects [4-6].

This study was aimed to compare the dexmedetomidine and buprenorphine as adjuvant in terms of onset and duration of sensory and motor block, haemodynamic parameters, post operative analgesia and side effects, if any.

METHODS:

After obtaining due permission from the institutional ethical committee and written informed consent from the patients, this hospital based, comparative, randomized , double blind study was conducted in seventy patients. Patients of ASA physical status I – II, age ranging between 30-50 years, height between 150-180 cm, who were scheduled to undergo lower limb elective surgeries. Patients with uncontrolled hypertension, infection at the injection site, disorders of coagulation, history of headache, reluctance to the procedure, neurologic disease or hypersensitivity to amide local anesthetics or dexmedetomidine and buprenorphine, were excluded from the study.

All patients underwent a thorough pre anesthetic checkup and were kept fasting overnight before the procedure. All routine monitoring were attached and preoperative baseline readings of Non Invasive Blood Pressure, Pulse Rate and Oxygen saturation were noted.

A good IV line was secured with 18G cannula and Ringer Lactate infusion was started. Patients were randomly allocated to two groups using chit in the box method. This trial was so planned that neither the doctor nor the participant was aware of the group allocation and the drugs received. Concept of VAS score was explained to patients.

Group D (n=35) received 15 mg(3 ml) of 0.5% hyperbaric bupivacaine + 5 mcg of dexmedetomidine + Normal saline to make the total volume 3.5 ml while Group B (n=35) received 15 mg(3 ml) of 0.5% hyperbaric bupivacaine + 60 mcg of buprenorphine + Normal saline to make the total volume 3.5 ml. The solutions were prepared by the anesthesiologist blinded to the study. Under all aseptic precautions, spinal anesthesia was performed in the operating room at the L3 – L4 or L2 – L3 interspace, with the patient in the sitting position. A volume of 3.5 ml was injected slowly through a 25-gauge spinal needle.

Intraoperative vitals (blood pressure, pulse rate, saturation) were recorded at 2,5,10,15,20,30,40,50,60 min interval and post operatively at 2, 4, 6, 8, 24 hr interval.

Onset of sensory block and motor block was noted using Modified Bromage score (0 : Able to move the hip, knee and ankle, 1 : Unable to move the hip but is able to move the knee and ankle, 2 : Unable to move the hip and knee but is able to move the ankle, 3 : Unable to move the hip, knee and ankle)
"Motor block duration" was recorded as time to complete termination of motor block.

"Maximum motor block level" was recorded as highest motor block

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scale (Bromage score) that was reached.

Following side effects were recorded:

- Hypotension (MAP < 60 mmHg or greater than 20% below the baseline)
- Bradycardia (Pulse < 50/min)
- Respiratory depression (oxygen saturation less than 90%)
- Pruritus

Episodes of intra-operative hypotension were managed with intravenous fluids and if required, with bolus doses of inj. mephenteramine 6 mg intravenously. Bradycardia was treated with 0.01 mg/kg of inj. atropine intravenously. Intra-operative nausea and pruritus,if any, were planned to be treated using ondansetron and antihistaminics respectively.

Total duration of analgesia was defined as time from intrathecal administration of drug to patient's demand of rescue analgesic. It was recorded following pain scoring system – Visual analogue score. Patient's VAS>3 and administration of rescue analgesia constituted the end point of the study. Inj. diclofenac (75mg) IM was given as rescue analgesic.

STATISTICAL ANALYSIS:

The sample size was calculated 35 for each group at alpha error 0.05 and power 80 percent.

Statistical assessment of data was done by using SPSS Statistical software (ver. 17.0) Within group, paired t-Test and between groups, student t-Test were applied. For significance in difference in proportion of cases with complications, Chi – Square test of significance was applied. A value of <0.05 was considered significant and <0.001 was considered highly significant. Data were expressed as mean ± standard deviation (SD) or median (range) or number of patients (n) or percentage (%).

RESULTS:

A total of 70 patients were enrolled in the study and randomly assigned equally to one of two studied groups. The two groups were comparable with respect to age, gender, height, ASA grade. (Table 1,2)

Table 1

	Group-B		Group-D		P-Value between groups
	Group-B	SD	Group-D	SD	
Age (yrs)	40.3	6.6	38.6	4.8	0.2258
Height (cm)	158.3	4.3	160.3	5.7	0.1075
ASA	1.0	0.0	1.0	0.0	Not Significant

Table 2

	GROUP B	GROUP D
MALE	32	31
FEMALE	3	4
TOTAL	35	35

Characterstics of spinal anaesthesia : (Table 3)

Sensory and motor block onset were comparable in both groups with p value >0.05 (insignificant). Duration of sensory block and motor block was longer in group D than group B (p<0.001) and the difference was highly significant. Duration of analgesia was significantly longer in group D than group B (p<0.05).(Fig 1) Lesser number of rescue analgesics were required by the patients in dexmedetomidine group as compared to buprenorphine group. (Fig 2)

Fig 1. Duration of analgesia

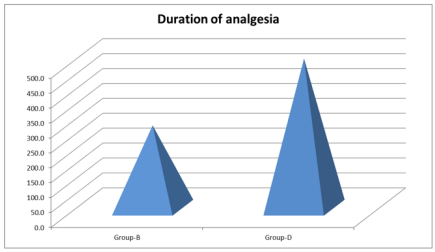


Fig 2. Number of rescue analgesics

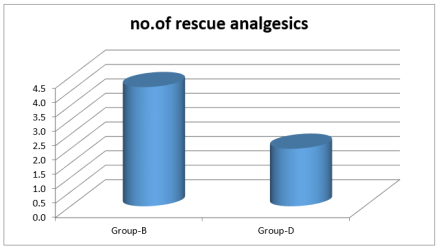


Table 3. Characteristics of spinal anaesthesia

	Group-B		Group-D		P-Value between groups
	Group-B	SD	Group-D	SD	
Onset in sensory block(minutes)	3.3	0.9	3.5	1.0	0.5289
Onset in motor block (minutes)	3.7	0.8	3.8	0.9	0.4724
Duration of sensory block (minutes)	223.9	36.9	449.8	27.7	0.0000
Duration of motor block (minutes)	199.8	35.9	398.8	20.2	0.0000
Duration of analgesia (minutes)	275.9	38.9	499.8	28.0	0.0000
Number of rescue analgesics	4.1	0.9	2.0	0.7	0.0001

Intraoperative and postoperative hemodynamic changes:

Both groups were comparable with respect to heart rate and mean arterial blood pressure values over different time intervals. (Fig.3,4) No significant difference was found between the two groups regarding fall in Mean Blood Pressure at different time intervals.

Fig 3. Trends of pulse rate in both groups.

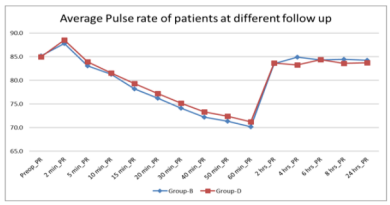
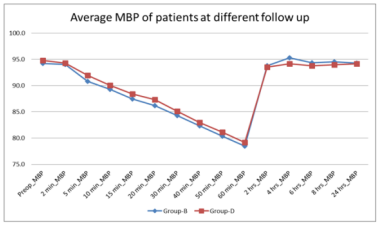


Fig 4. Trends of Mean Arterial Pressure in both groups.



Complications

There was no significant difference in the incidence of side effects

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(e.g. hypotension, bradycardia, nausea, vomiting, shivering, pruritus) in both groups (p>0.05) In group D 34.3 % patients and in group D 37.1 % patients showed hypotension (Table 4)

Table 4. Percentage of patients showing hypotension.

Hypotension	Group B		Group D		P value
	Number	Percentage	Number	Percentage	0.803
Yes	13	37.1	12	34.3	
No	22	62.9	23	65.7	
	35	100.0	35	100.0	

DISCUSSION

70 patients of similar demographic profile and ASA physical status1 and 2 were studied. Using 5 mcg dexmedetomidine provided longer duration of analgesia,sensory and motor blockade as compared to the use of 60 mcg of buprenorphine when added to 15 mg 0.5% hyperbaric bupivacaine .

Different agents have been used as adjuncts for prolonging the duration of spinal anaesthesia. Al - Ghanem et al.'s[7] study concluded that 5mcg dexmedetomidine seems to be effective as adjuvant to spinal bupivacaine in surgical procedures and provided adequate post operative analgesia. Therefore dexmedetomidine in a dose of 5 mcg was used in the present study.

Narcotics co administered with local anaesthetics intrathecally have a potent synergistic effect[8] . Buprenorphine is a centrally acting partial opioid agonist and has both spinal and supraspinal component of analgesia. Added to Bupivacaine intrathecally, it improved the quality and duration of postoperative analgesia compared to Bupivacaine alone.[9]. Shaikh et al. showed that 1 μg/kg Buprenorphine to a maximum of 50 μg when added to 15 mg of 0.5% heavy Bupivacaine intrathecally provides analgesia for 476.6±93.7 minutes .[10]. .So in present study, buprenorphine in the dose of 60 mcg was used.

The duration of analgesia in buprenorphine group in present study was found to be 275.9 minutes which is lesser than the results observed by Capogna et al.,[9] where the duration of analgesia was 430 minute in the buprenorphine group. This could be because Capogna studied elderly patients. In present study,we found that the duration of analgesia in the dexmedetomidine group was 499.8 minutes. This is comparable with studies done by Shah et al.[11], where 5μg dexmedetomidine had a duration of analgesia 474 minutes. Duration of analgesia was significantly prolonged with the addition of 5μg dexmedetomidine to 478 minutes in the study done by Gupta et al [12]. In a similar study done by Nayagam et al[13]. the duration of analgesia after addition of 5 mcg of dexmedetomidine was found to be 8.20 +/- 2.78 hrs which is found to be in resonance with our results.Study done by Eid et al.[14], showed that duration of analgesia with dexmedetomidine is proportional to its dose.

The onset of sensory and motor block in present study was comparable with the studies done by Shukla et al., [15] and Shaikh and Kiran [10] for dexmedetomidine and buprenorphine respectively. The onset of sensory block in buprenorphine group according to a study done by Fauzia A. Khan et al [16] showed it to be 4.3 +/- 1 min where they used a buprenorphine dose of 30 mcg. The duration of sensory block in present study was 223.9 min in Buprenorphine group and 449.8 min dexmedetomidine group. Similar results have been shown in the study done by Mahima Gupta et al. [17]

The duration of motor block in present study was 398.8 minutes in the dexmedetomidine group which is comparable with the studies done by Gupta et al.,[18] where duration of motor block was 421 minutes.In a study done by Yektas et al [19], the duration of motor block with dexmedetomidine was found to be 226.5 min. This is probably because a lower dose of dexmedetomidne, 4mcg, was used in their study. The duration of motor block is significantly prolonged in comparison to duration of motor block in the buprenorphine group, 199.9 minutes which is in accordance with the study done by Mahima Gupta et al[17]

α2-adrenoceptor agonist bind to pre-synaptic C-fibres and post-synaptic dorsal horn neurons. Their analgesic action is due to depression of the release of C-fibre transmitters and by hyperpolarisation of post-synaptic dorsal horn neurons. [20] It may be an additive or synergistic effect secondary to the different mechanisms of action of the local anaesthetics and the α2-adrenoceptor agonist as studied by Salgado et al. [21] This antinociceptive effect may explain the prolongation of the sensory block when added to spinal anaesthetics. The prolongation of the motor block of spinal anaesthetics is due to the binding of α2-adrenoceptor agonists to motor neurons in the dorsal horn. [22,23]

A trend of decrease in pulse rate was observed in both the groups after the subarachnoid block was performed. But none of the patients in present study needed any intervention in the form of iv atropine throughout the surgery. This is in accordance with the study done by Dixit et al [24] where no case of bradycardia was seen in the buprenorphine group. In a study conducted by Mahmoud M. Al-Mustafa et al [25] only 1 case of bradycardia was reported when a 5 mcg dose of dexmedetomidine was used while no case of bradycardia was seen when a dexmedetomidine dose of 10 mcg was used and this supports the results of present study. Dexmedetomidine causes bradycardia but the effect is more prominent when administered intravenously and with a higher dose[26].

A trend of decrease was observed in the MAP readings in both the groups of present study. Hypotension was observed in 13 patients in buprenorphine group and 12 patients in dexmedetomidine group. The fall in MAP observed in the Dexmedetomidne group is similarly shown in the study conducted by Nayagam et al [13]. The fall in MAP observed in the Buprenorphine group is similarly shown in the study done by Fauzia A. Khan et al[16]. Sedation scores for dexmedetomidine were observed in a study done by Rajni Gupta et al [18] This action of dexmedetomidine is attributed to its action on the α-2 receptors in locus ceruleus. Sedative effects of Dexmedetomidine are prominent when given as intravenous bolus, continuous infusion, or Intramuscular injections[27].

Lesser number of rescue analgesic doses were required by the patients in dexmedetomidine group (2+/- 0.7) as compared to buprenorphine(4.1+/-0.9). Gupta et al[14] also concluded that after addition of dexmedetomidine 5 mcg to ropivacaine,less number of rescue analgesics were required in the first 24 hrs. The α-2 adrenergic agents also have antishivering property as observed by Talke et al., [28] but no incidence of shivering was found in both the groups in present study. No incidences of nausea, vomiting, respiratory depression were observed in any of the patients in present study. Buprenorphine is partial agonist with high molecular weight and lipophilic, which may prevent its rostral spread and thus respiratory depression, prolongs the duration of sensory block and hence decreases the need for postoperative analgesia [29]. It was concluded that, the onset of sensory and motor blockade with both dexmedetomidine and buprenorphine were comparable. The duration of motor and sensory block in dexmedetomidine group was significantly longer as compared to buprenorphine group. Similarly duration of analgesia was also significantly longer in dexmedetomidine group as compared to buprenorphine group.

CONCLUSION:

Hence we concluded that intrathecal dexmedetomidine 5μg when compared to intrathecal buprenorphine 60μg caused prolonged duration of sensory and motor block and duration of analgesia. The requirement of rescue analgesia was lesser in dexmedetomidine group and the haemodynamics are similar in both the groups without causing any significant side effects.

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