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Effect Of Adding Dexmedetomidine In Intrathecal Bupivacaine Versus Intrathecal Bupivacaine Alone On Spinal Block Characteristics In Orthopaedic Lower Limb Procedures [A Comparative Study]

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ABSTRACT

Problem statement: The purpose of this study was to evaluate the onset and duration of sensory and motor block as well as operative analgesia and adverse effects of dexmedetomidine given intrathecally with hyperbaric 0.5% bupivacaine or hyperbaric 0.5% bupivacaine alone for spinal anaesthesia. sixty patients classified as American Society of Anaesthesiologists (ASA) status I, II and III scheduled for lower limb orthopaedic surgeries were prospectively studied. Patients were randomly allocated to receive intrathecally either 15 mg hyperbaric bupivacaine plus 5 µg dexmetedomidine (group D n = 30) or 15 mg hyperbaric bupivacaine (group S n = 30), the onset time to reach peak sensory and motor level, the regression time for sensory and motor block, hemodynamic changes, and side effects were recorded. Patients in group D had significant longer sensory and motor block times than patients in group S. the mean time of sensory regression to S1 was 306±21.8 min in group D and 192±9.9min in group S (P 0.0000). The regression time of motor block to reach modified Bromage 0 was 236±16.6 min in group D and 162.5±7.5 min in group S (P 0.0000). The onset times to reach T10 dermatome as well as onset time to reach modified Bromage 3 motor block were slightly higher in group D.In patients undergoing lower limb orthopedic surgeries surgery under spinal analgesia, 15 mg hyperbaric bupivacaine supplemented with 5 µg dexmetedomidine produces prolonged motor and sensory block compared with hyperbaric 0.5% bupivacaine alone.

Keywords: Low dose spinal anaesthesia, bupivacaine+ Dexmedetomidine.

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INTRODUCTION

Spinal anaesthesia is the most commonly used technique for lower abdominal surgeries as it is very economical and easy to administer. However, postoperative pain control is a major problem because spinal anaesthesia using only local anaesthetics is associated with relatively short duration of action, and thus early analgesic intervention is needed in the postoperative period. A number of adjuvants, such as clonidine and midazolam, and others have been studied to prolong the effect of spinal anaesthesia [1, 2].

A common problem during lower abdominal surgeries under spinal anaesthesia is visceral pain, nausea, and vomiting [3, 4]. Dexmedetomidine, a new highly selective α2-agonist, is under evaluation as a neuraxial adjuvant as it provides stable hemodynamic conditions, good quality of intraoperative and prolonged postoperative analgesia with minimal side effects [4]. Dexmedetomidine has been approved by Food and Drug Administration (FDA) as a short-term sedative for mechanically ventilated intensive care unit (ICU) patients. Based on earlier human studies, it is hypothesized that intrathecal 5 µg dexmedetomidine would produce more postoperative analgesic effect with hyperbaric bupivacaine in spinal anaesthesia with minimal side effects [5, 6, 7].

MATERIALS AND METHODS

After approval of ethical committee of the institution, the study was conducted in sixty patients posted for orthopaedic lower limb surgeries. Written informed consent was obtained from all patients. Inclusion criteria were American Society of Anaesthesiologists (ASA) physical status I or II, either sex, age 18-50 years, presenting for lower limb orthopaedic surgeries. Exclusion criteria were patient allergic to drug, heart block/dysrhythmia, or on therapy with adrenergic receptor antagonist, calcium channel blocker, and/or ACE inhibitor.

The patients were preloaded with Lactated Ringer's solution 15 mL/kg. They were monitored with automated non-invasive blood pressure, pulse oximetry, and electrocardiogram. 23G BD spinal needles were introduced through L3-L4 interspaces in sitting position using aseptic precautions. Patients were randomly divided into the following groups: Group D-to receive 3 mL volume of 0.5% hyperbaric bupivacaine and 5 µg dexmedetomidine in 0.5 mL of normal saline intrathecal (dexmedetomidine (100 µg/mL) was diluted in preservative-free normal saline) and Group S-to receive 3 mL volume of 0.5% hyperbaric bupivacaine and 0.5 mL of normal saline. Immediately after completion of the injection patients were made to lie supine.Haemodynamic monitoring done at 5min interval

Oxygen (4 L/min) was administered via a venturi mask. Hypotension, defined as a decrease of systolic blood pressure by more than 30% from baseline or a fall below 90 mmHg, was treated with incremental IV doses of mephentermine 6 mg and IV fluid as required. Bradycardia, defined as heart rate < 60 bpm, was treated with IV atropine 0.3-0.6 mg. The incidence of adverse effects, such as nausea, vomiting, shivering, pruritus, respiratory

depression, sedation, and hypotension were recorded. Sensory testing was assessed by loss of pinprick sensation to 23G hypodermic needle and dermatomes levels were tested every 2 min until the highest level had stabilized by consecutive tests. On achieving T10 sensory blockade level, surgery was allowed. Testing was then conducted every 10 min until the point of two segment regression of the block was observed. Further testing was performed at 20-min intervals until the recovery of S1 dermatome. The surgeon, patient, and the observing anaesthesiologists were blinded to the patient group. Data regarding the highest dermatome level of sensory blockade, the time to reach this level from the time of injection, time to S1 level sensory regression, and incidence of side effects were recorded. Sedation was assessed by a modified Ramsay sedation scale.

Modified Ramsay sedation scale

- Anxious, agitated, restless.
- Cooperative, oriented, tranquil.
- Responds to commands only.
- Brisk response to light glabellar tap or loud noise.
- Sluggish response to light glabellar tap or loud noise.
- No response.

Postoperatively, the pain score was recorded by using visual analogue pain scale (VAS) between 0 and 10 (0 = no pain, 10 = most severe pain), initially every 1 h for 2 h, then every 2 h for the next 8 h and then after every 4 h till 24 h. Diclofenac was given intramuscularly as rescue analgesia when VAS was >4. A follow-up was carried out 1 week postoperatively by the blinded anaesthesiologists, who asked about postoperative headache as well as postoperative pain and dysesthesia in the buttock, thighs, or lower limbs.

Statistical analysis was done using the Epi-Info-7. To calculate the sample size, a power analysis of α=0.05 and α=0.90, showed that 30 patients per study group were needed. Data are expressed as either mean or standard deviation or numbers and percentages.8 Continuous covariates were compared using analysis of variance (ANOVA). The comparison was studied using the Kruskal-Wallis H (equivalent to Chi square), with the P value reported at the 95% confidence interval. $P<0.05$ was considered statistically significant.

RESULTS

The groups were comparable with respect to age, height, and weight, and ASA physical status and there was no significant difference in the type and duration of surgery [Table I].

The characteristics of sensory block and motor block are summarized in [Table II]. There was no difference between groups D and S in the highest level of block achieved in the two groups (T5 and T6, respectively) or in the time to reach peak level. Block regression was significantly slower with the addition of intrathecal dexmedetomidine as compared with group S, as time to S2 regression was significantly more with intrathecal dexmedetomidine. There was

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no difference in the onset time to Bromage 3 motor block but the regression of motor block to Bromage 0 was significantly slower with the addition of dexmedetomidine [Table II].

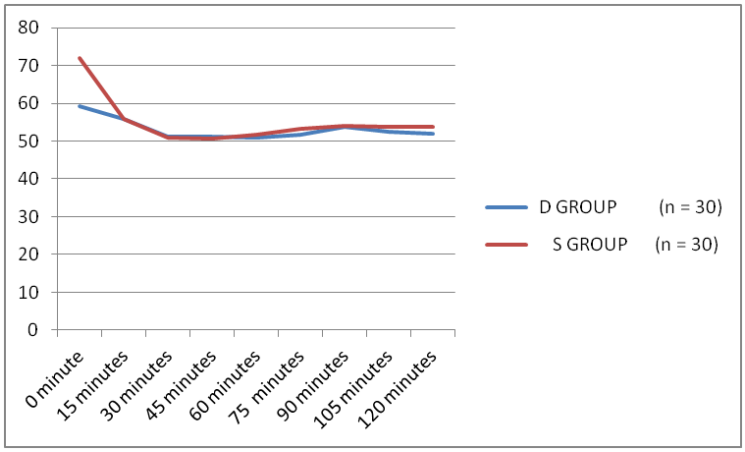
Table I: Demographic data

VARIABLE	D GROUP (n=30)	S GROUP(n=30)	"p"
Age in years	43.1 ± 18.4	44.9 ± 14.4	(Not Significant) P value > 0.05
Weight (in kg)	59 ± 7.1	59.5 ± 5.1	
Height (in cm)	160.1 ± 6.3	162 ± 6.1	
BMI	23.9 ± 2.76	23.8 ± 2.64	
Duration of surgery(min)	150.7±3.2	143.1±3.4	

TABLE-2

Mean	D GROUP (n = 30)	S GROUP (n = 30)	P value
Onset of sensory blockade (min)	6.2 ± 1.6	4.1 ± 0.8	(p > 0.05)
Onset of motor blockade (min)	8.6 ± 1.6	5.8± 0.8	(p > 0.05)
sensory recovery time(min)	306 ± 21.8	192 ± 9.9	(p < 0.05)
motor recovery time(min)	236 ± 16.6	162.5 ±7.5	(p < 0.05)

Hemodynamic changes



Graph -1 Mean arterial blood pressure in mm of Hg

Graph 1 shows mean B.P. at different time intervals, with maximum fall occurring at 15 minutes, after giving spinal anesthesia in both the groups. Fall in blood pressure in both groups were quite comparable and statistically insignificant. (p=0.64)

The graph 2 shows statistically significant lower pulse rates for the Dexmedetomidine group but within acceptable limits. (p=0.003)

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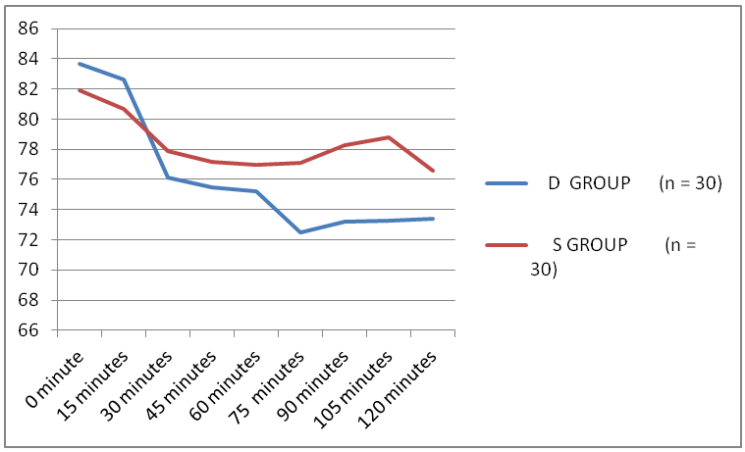
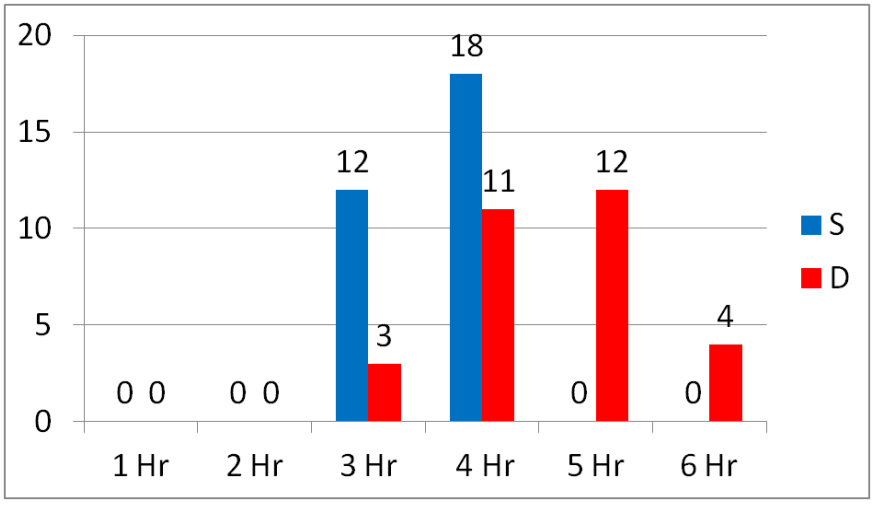
The incidence of hypotension and thus use of vasopressor was higher in group D (30%) than group A (16.6%). This difference was found to be statistically insignificant.
The incidence of bradycardia and thus use of atropine was higher in group B (12.4%) than group A (9.1%). This difference was not found to be statistically significant.



Graph -2 Pulse rate per minute

The time to rescue analgesic was significantly longer in group D as compared to group S. [Graph -3].



Graph -3 Numbers of patients receiving rescue analgesics

Mean sedation score at 60 minutes in group D was 1.73 as compared to group S which was 1($p < 0.05$).

DISCUSSION

The mechanism by which intrathecal α_2 -adrenoceptor agonists prolong the motor and sensory block of local anesthetics is not well known. They act by binding to presynaptic C-fibers

and postsynaptic dorsal horn neurons. Their analgesic action is a result of depression of the release of C-fibre transmitters and hyperpolarisation of postsynaptic dorsal horn neurons [8]. Local anaesthetic agents act by blocking sodium channels. The prolongation of effect may result from synergism between local anaesthetic and α_2 -adrenoceptor agonist, while the prolongation of the motor block of spinal anesthetics may result from the binding of α_2 -adrenoceptor agonists to motor neurons in the dorsal horn [9] Intrathecal α_2 -receptor agonists have been found to have antinociceptive action for both somatic and visceral pain.

The use of intrathecal clonidine has been studied with local anaesthetics [10]. Studies using a combination of intrathecal dexmedetomidine and local anaesthetics are lacking. In our study, the intrathecal dose of dexmedetomidine selected was based on previous animal studies [11, 12]. A number of animal studies conducted using intra thecal dexmedetomidine at a dose range of 2.5-100 µg did not report any neurologic deficits with its use [13, 14, 15, 16].

Fukushima *et al* administered 2 µg/kg epidural dexmedetomidine for postoperative analgesia in humans but did not report neurologic deficits [17]. Our study has shown that the addition of 5 µg dexmedetomidine with hyperbaric bupivacaine significantly prolongs both sensory and motor block. The analgesia was clinically better in group D as compared to group S but it was not statistically significant. Small doses of intrathecal dexmedetomidine (3µg) used in combination with bupivacaine in humans have been shown to shorten the onset of motor block and prolong the duration of motor and sensory block with hemodynamic stability and lack of sedation [6]. Al-Ghanem *et al* had studied the effect of addition of 5 µg dexmedetomidine or 25 µg fentanyl intrathecal to 10 mg isobaric bupivacaine in vaginal hysterectomy and concluded that 5 µg dexmedetomidine produces more prolonged motor and sensory block as compared with 25 µg fentanyl [4].

In our study, in the dexmedetomidine group we found longer duration of both sensory and motor blockade, stable hemodynamic condition, and good patient satisfaction. Al-Mustafa *et al* studied effect of dexmedetomidine 5 and 10 µg with bupivacaine in urological procedures and found that dexmedetomidine prolongs the duration of spinal anaesthesia in a dose-dependent manner[5].

In our study hypotension was more in the dexmedetomidine group than in the saline group, but it was not statistically significant. A 4-week follow-up showed that intrathecal dexmedetomidine, at a dose of 5 µg, was not associated with any new onset of back, buttock, or leg pain, weakness or neurologic deficit. The α-2 adrenergic agents also have anti shivering property as observed by Talke *et al*. [19] We too did not find any incidence of shivering in the D group.

Group D patients have

- Late Sensory and motor onset time
- Prolonged motor recovery time
- Prolonged post-operative analgesia
- Slightly better sedation

Than Group S patients

In conclusion, 5 µg dexmedetomidine seems to be an attractive adjuvant to spinal bupivacaine in surgical procedures. It provides good quality of intraoperative analgesia, hemodynamically stable conditions, minimal side effects, and excellent quality of postoperative analgesia.

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