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# COMPARATIVE STUDY OF HYPERBARIC 0.5% BUPIVACAINE AND HYPERBARIC 0.5% BUPIVACAINE WITH LOW DOSE (5MICROGRAM) DEXMEDETOMIDINE IN SPINAL ANAESTHESIA

Anaesthesiology

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## ABSTRACT

**Background:** Intrathecal adjuvants have gained popularity with the aim of prolonging the duration of block, quality of block and decreased resource utilization compared with general anaesthesia. In present study, we studied onset and duration of sensory and motor block as well as adverse effects of adding Dexmedetomidine (5µg) as an adjuvant to intrathecal 0.5% heavy bupivacaine and of intrathecal 0.5% heavy bupivacaine alone for lower limb surgeries.

**Method:** This was a prospective, randomised control study conducted in 90 Patients of ASA grade I and II undergoing elective surgeries under spinal anaesthesia .The patients were randomly allocated to two groups of 45 each to receive intrathecally either 15 mg (3ml ) hyperbaric bupivacaine alone(group B) or 5µg (group D5) of dexmedetomidine added to 15 mg hyperbaric bupivacaine. The onset time to reach T10 sensory and Bromage 3 motor level, the regression time for S1 sensory and Bromage 0 motor block, Sedation scores, hemodynamic changes and side effects were recorded.

**Results:** It was concluded from present study that in Dexmedetomidine group time to reach T10 sensory blockade and complete motor blockade was earlier and a higher level of sensory blockade compared to control group achieved. Duration of sensory, motor blockade and duration of analgesia was significantly prolonged in the Dexmedetomidine group compared to the control group.

**Conclusions:** Intrathecal low dose Dexmedetomidine in a dose of 5µg along with 0.5% hyperbaric bupivacaine is a better adjuvant for spinal anaesthesia in patients undergoing elective lower limb surgeries

## KEYWORDS

Dexmedetomidine, bupivacaine, spinal anesthesia, intrathecal, adjuvant.

## INTRODUCTION

Spinal anaesthesia remains one of the basic techniques in the arsenal of modern anaesthesiology despite the waxing and waning of its popularity over last 100 years since its introduction into clinical practice. It avoids biochemical and metabolic changes consequent to the stress of general anaesthesia for surgery as well as provides near optimal conditions for surgery. The main advantage being its simplicity, ease of performance, reliability, requirement of minimal apparatus and minimal effect on blood chemistry apart from producing dense sensory and motor blockade.

Its main disadvantage relates to its limited duration of action and hence lack of long-lasting post-operative analgesia. In recent years, use of intrathecal adjuvants has gained popularity with the aim of prolonging the duration of block, better success rate, patient satisfaction, decreased resource utilization compared with general anaesthesia and faster recovery. The quality of the spinal anaesthesia has been reported to be improved by the addition of opioids such as morphine, fentanyl and sufentanil and other drugs such as dexmedetomidine, clonidine, magnesium sulfate, neostigmine, ketamine and midazolam. [1]

Dexmedetomidine is a highly selective α2-adrenergic agonist which has been used as pre-medication and as an adjuvant to general anesthesia. Dexmedetomidine have several beneficial actions during perioperative period. They decrease sympathetic tone with attenuation of the neuroendocrine and haemodynamic response to anaesthesia and surgery, reduce anaesthetic and opioid requirement, cause sedation and analgesia. Dexmedetomidine was first introduced into clinical practice as a short term intravenous sedative in intensive care. Like any other adjuvant dexmedetomidine is not free from adverse effects. Use of dexmedetomidine is often associated with a decrease in heart rate and blood pressure. [2]

Various animal studies have been conducted using intrathecal dexmedetomidine at a dose range of 2.5 to 100 µg without any neurological complications [2]. Antinociceptive effect of dexmedetomidine, a highly selective alpha 2 adrenergic agonist was evaluated in animal studies [3]. Dexmedetomidine was used to enhance the analgesic property of local anaesthetics like lidocaine, bupivacaine and ropivacaine. In vivo and in vitro studies indicated that these local anaesthetics had significant neurotoxicity [4]. Dexmedetomidine showed protective or growth promoting properties in tissues, including nerve cells from cortex. Dexmedetomidine helps in the prevention of local anesthetic induced neurotoxicity when used together with local anesthesia agents. [4]

## METHODS

The study was carried out in tertiary care hospital and study protocol was approved by Institutional Ethics Committee. The study was a prospective, randomised, single-blind, controlled, single centre study. Patients were examined one day prior to surgery and baseline recordings of pulse rate, blood pressure and other vitals were recorded. Informed written consent was obtained from the patients prior to joining the study. Randomization was used to minimize bias.

The study consists of 90 patients in the age group 20-55 years of either gender belonging to ASA grade I and II scheduled for lower limb surgeries. Patients were randomly allocated in 2 groups. Each group consisted of 45 patients having Group-B as Control group which received 0.5% hyperbaric bupivacaine 3cc (15 mg) and Group-BD which received 0.5% hyperbaric bupivacaine 3cc (15mg) + 5µg Dexmedetomidine. Patients using beta blockers, calcium channel blockers, angiotensin converting enzyme inhibitors, or noted to have dysrhythmias on the electrocardiogram (ECG), a body weight of more than 100 kg, or height less than 150 cm were excluded from the study. Premedication was avoided to the study group patients prior to surgery.

Standard monitoring was used, including non-invasive arterial blood pressure (BP), ECG, heart rate (HR) and pulse oximetry (SpO2). Preloading was done with 10 ml/kg of crystalloid solution. With the patient in the sitting position, spinal anesthesia was performed at the level of L3-L4 through a midline approach using a 25-gauge Quincke spinal needle. Spinal block characteristics, mean arterial pressure, Mean pulse rate, sedation and side effects were studied during intraoperative and postoperative period.

The sensory dermatome level was assessed by pin prick sensation using 23 gauge hypodermic needle along the mid clavicular line bilaterally.

The motor dermatome level was assessed according to the modified Bromage scale:
Bromage 0, the patient is able to move the hip, knee and ankle;
Bromage 1, the patient is unable to move the hip, but is able to move the knee and ankle;
Bromage 2, the patient is unable to move the hip and knee, but is able to

move the ankle;
Bromage 3, the patient is unable to move the hip, knee and ankle.

The sensory level and Bromage scale were recorded pre-spinal injection and every two minutes after the spinal injection up to the 10th minute and after that every 3 minutes until the highest dermatome was reached. In the PACU, the sensory level and Bromage scale were recorded every 15 minutes until the patient was discharged from the PACU. All durations were calculated considering the time of spinal injection as time zero. When sensory levels of anesthesia were not equal bilaterally, the higher level was used for the statistical analysis. Patients were discharged from the PACU after sensory regression to the S1 segment, and Bromage scale of 0.

The level of sedation was evaluated just before surgery, intra operatively and post-operatively every 15 minutes using the Ramsay sedation scales:
scale 1 - patient anxious, agitated, or restless;
scale 2 - patient cooperative, oriented, and tranquil alert;
scale 3 - patient responds to commands;
scale 4 - Asleep, but with brisk response to light glabellar tap or loud auditory stimulus;
scale 5 - Asleep, sluggish response to light glabellar tap or loud auditory stimulus and
scale 6 - Asleep, no response. Patients neurological assessment was done every day and recorded during hospital stay.

## RESULTS

90 patients were enrolled in the study. All the patients completed the study protocol and were included in the data analysis. Thus group B, group D5 consisted of 45 patients each. There was no significant difference in the demographic data between the two study groups [ p >0.05] (Table 1).

**Table 1: Demographic data (mean±SD) in two study groups.**

| Characteristics | Group B (Mean ± SD) | Group BD (Mean ± SD) | "p value" |
|---|---|---|---|
| Age (years) | 43.63 ± 11.45 | 43.9 ± 9.33 | 0.90 |
| Weight (kgs) | 63.70 ± 7.43 | 61.13 ± 5.19 | 0.06 |
| Height (cms) | 159.26 ± 7.292 | 161.62 ± 7.931 | 0.145 |
| Gender (Males) | 22 (48.9%) | 21(46.7%) | |
| Females | 23(51.1%) | 24(53.3%) | |

By using 2 independent sample t-test p-value >0.05, hence there is no significant difference between mean age (years), mean Height (cm), mean weight (kg) in group B and group BD.

By using 2 sample proportion test p-value >0.05 hence, there is no significant difference between proportion of gender in group B and group BD.

**Table 2: Spinal block characteristics.**

| Spinal Block Characteristics | Group B Mins.(Mean±SD) | Group BD Mins.(Mean±SD) | "p" value |
|---|---|---|---|
| Time to reach T10 sensory blockade | 5.43 ± 0.93 | 4.23 ± 0.93 | <0.001 |
| Time to reach maximum level of sensory blockade | 12.66 ± 1.14 | 11.4 ± 0.99 | <0.001 |
| Time required for maximum motor blockade | 9.20 ± 1.21 | 7.04 ± 1.05 | <0.001 |
| Duration of two segment regression | 86.65 ± 11.49 | 152.32 ± 13.60 | <0.001 |
| Duration of sensory regression to S1 | 128.54 ± 10.07 | 302.20 ± 20.69 | <0.001 |
| Total duration motor blockade | 146.67 ± 15.50 | 270.70 ± 24.07 | <0.001 |
| Duration of analgesia | 139.50 ± 19.72 | 371.63 ± 24.57 | <0.001 |

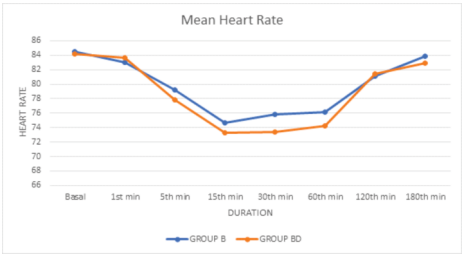
In Dexmedetomidine group time to reach T10 sensory blockade and complete motor blockade was earlier and a higher level of sensory blockade compared to control group achieved. Duration of sensory, motor blockade and duration of analgesia was significantly prolonged in the Dexmedetomidine group compared to the control group.

**Table 3: Sedation score.**

| Sedation score | Group B | Group BD | Total | "p" value |
|---|---|---|---|---|
| 1 | 2 | 0 | 2 | |
| 2 | 43 | 36 | 79 | <0.001 |
| 3 | 0 | 9 | 9 | |
| Total | 45 | 45 | 90 | |

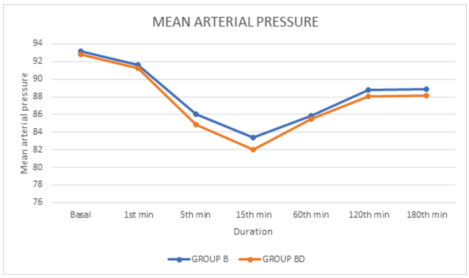
By using Mann Whitney U test p-value < 0.05 therefore there is significant difference between sedation score in group B and group BD

**Table 4: Mean HR at various duration.**




There is no significant difference between mean pulse rate in group B and group BD (p value >0.05). Maximum fall in mean pulse rate was seen at 15 minute in both group and was both statistically and clinically insignificant.

**Table 5: Mean MAP at various duration**




There is no significant difference between mean MAP in group B and group BD (p value >0.05). Maximum fall in mean MAP was seen at 15 minute in both group and was both statistically and clinically insignificant.

**Table 6: Side effects.**

| Side effects | Group B | Group BD | P value | Significance |
|---|---|---|---|---|
| PONV | 0 | 1 | >0.05 | NO |
| Bradycardia | 2 | 1 | >0.05 | NO |
| Hypotension | 1 | 0 | >0.05 | NO |
| Atropine | 2 | 1 | >0.05 | NO |

One patient in Group B and none in Group BD had hypotension which required vasopressors and additional fluids. This difference was found to be statistically not significant (p >0.05) by using chi-square test. Two patients in Group B required Inj. Atropine for bradycardia while one patient in Group BD required treatment for bradycardia. The difference was statistically insignificant (p >0.05) by using chi-square test.

PONV was experienced by only one patient in Group BD while no patients in Group B experienced it which is statistically insignificant (P >0.05) by using chi-square test.

## DISCUSSION

Prolongation of duration of spinal block is desirable both for long procedures and for postoperative pain relief. Different agents, such as epinephrine, phenylephrine, adenosine, magnesium sulfate, and clonidine have been used as adjuvant for prolonging the duration of spinal anesthesia.

The mechanism by which intrathecal alpha 2-adrenergic agonists prolong the motor and sensory block of local anesthetics is not clear. It may be an additive or synergistic effect secondary to the different mechanisms of action of local anesthetic and alpha 2 adrenergic agonist. The local anesthetics act by blocking sodium channels, whereas the alpha 2 adrenergic agonist acts by binding to pre synapytic C fibre and post synaptic dorsal horn neurons. Intrathecal alpha 2 adrenergic agonist produce analgesia by depressing the release of C fibre transmission by hyperpolarization of post synaptic dorsal horn neurons.[7] Li et al observed that Glutamate is involved in excitatory neurotransmission nociception and plays an essential role in relaying

noxious stimuli in the spinal cord. Intrathecal injection of alpha 2 adrenergic agonists produces potent antinociceptive effects by altering spinal neurotransmitter release and effectively treats acute pain[5,6].

The first use of intrathecal Dexmedetomidine in humans based on previous animal studies was reported by Khanazi et al, in 2006.[6] Dexmedetomidine is an highly selective, specific and potent alpha- 2 adrenergic agonist. It is eight times more alpha-2 selective than Clonidine, producing faster onset and significantly longer duration of analgesia than bupivacaine alone, when used as an adjuvant.[6]

Largest dose of dexmedetomidine used intrathecally in humans was 10 µg.[7] Previous Studies revealed hemodynamic stability with 5 and 10 µg of dexmedetomidine as intrathecal adjuvant [8] . Rajni gupta et al found intrathecal dexmedetomidine (5 µg) with bupivacaine is associated with prolonged motor and sensory block, hemodynamic stability and statistically significant sedation score[9] .

Al-Mustafa et al[7] compared the doses of dexmedetomidine 5, 10 µg in isobaric bupivacaine 12.5mg (total volume:3 ml) with plain isobaric bupivacaine without premedication and found the effect to be dose dependent on the onset and regression of sensory and motor block with comparable sedation scores among three groups. Kamat et al[10] used 10 µg of dexmedetomidine in 3ml of 0.5% hyperbaric bupivacaine and found the similar results.

It was found from our study that in Dexmedetomidine group time to reach T10 sensory blockade and complete motor blockade was earlier as compared to control group. Complete sensory blockade achieved was higher with dexmedetomidine group as compare to control group. Duration of sensory, motor blockade and duration of analgesia was significantly prolonged in the Dexmedetomidine group compared to the control group. Hemodynamic parameters were preserved both intra-operatively and postoperatively. However, there were a small percentage of patients who developed hypotension and bradycardia which were easily managed without any untoward effect. More number of patients in the Dexmedetomidine group was sedated but easily arousable. Only one patient from Dexmedetomidine group developed nausea. No patient had any respiratory depression, shivering or CVS side effects like change in rate and rhythm, in either of the groups and hence can be an attractive alternative for opioids for prolonging spinal analgesia. It may be more suitable for major surgeries on abdomen and lower extremities. The drawback of intrathecal Dexmedetomidine is increase in duration of motor blockade which may not be suitable for short duration of surgeries. Hence Dexmedetomidine is a better neuraxial adjuvant for providing early onset of sensory and motor blockade, prolonged sensory blockade and post-operative analgesia and adequate sedation.

## CONCLUSION

From the present study it was concluded that intrathecal low dose Dexmedetomidine in the dose of 5µg along with 3 cc 0.5% hyperbaric bupivacaine, lead to an earlier onset and prolonged duration of sensory and motor blockade, excellent postoperative analgesia, with minimal adverse effects and stable hemodynamic conditions.

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