



## COMPARISON OF INTRATHECAL DEXMEDETOMIDINE AND MAGNESIUM SULPHATE AS AN ADJUVANT TO 0.5% HYPERBARIC BUPIVACAINE IN LOWER LIMB SURGERY

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**ABSTRACT** **Background:** Epidural anesthesia is commonly used for perioperative as well as postoperative analgesia in lower limb surgeries. Adjuvant in spinal anesthesia prolongs the duration of anesthesia as well as postoperative analgesia. In this study we evaluate the effects of intrathecal dexmedetomidine and magnesium sulfate as an adjuvant to 0.5% hyperbaric bupivacaine in lower limb surgeries.

**Methods:** Total 60 patients belonging to ASA I or II aged 24 to 57 years of either sex were included in this study and randomly distributed into two groups. Group (B+M) received intrathecal 100mg magnesium sulfate and Group (B+D) received intrathecal 5.0 mcg dexmedetomidine with hyperbaric bupivacaine 15mg (3ml of 0.5%). Onset and duration of sensory and motor block, duration of analgesia, hemodynamic changes and complications were recorded.

**Results:** The mean Onset time of sensory block at T10 (min.), Time to maximum sensory block level (min.), Time in minutes for complete motor block (min.), Time for Motor Emergence from Bromage 3 (min.), Time for Sensory Emergence and Time for first analgesia (min) were significantly different between groups.

**Conclusion:** The dexmedetomidine as an adjuvant with hyperbaric bupivacaine leads to earlier onset and prolonged duration of both sensory and motor block as compared to magnesium sulfate.

**KEYWORDS :** Intrathecal, Bupivacaine, Dexmedetomidine, epidural block, magnesium

### INTRODUCTION

Pain is an unpleasant feeling that begins from continuous and approaching tissue harm. Epidural is the safe and effective anaesthesia providing intra-operative and postoperative analgesia. Till day, no drug has been distinguished that explicitly represses nociception without related side effects [1].

Epidural anesthesia is the most frequently used technique for perioperative as well as post-operative analgesia in lower limb surgeries [2]. Quick postoperative mobilization and rehabilitation with essentially associated pain and distress is the best component in present day orthopaedic surgery [3-5]. Many a period for accomplishing wanted peri-operative sedative impact, constantly enormous volumes of local anaesthetics are utilized, in this way expanding the potential outcomes of nearby sedative harmfulness and malicious haemodynamic results.

Various recent studies reported that the utilization of intrathecal adjuvants has prolong the duration of block, increased the success rate, patient satisfaction, faster recovery and diminished the asset use compared with general anaesthesia. The nature of spinal anaesthesia has been improve with the addition of opioids such as morphine, fentanyl, and sufentanil and different medications like ketamine, midazolam, dexmedetomidine, clonidine and magnesium sulphate [6]. Recent studies suggest the role of magnesium sulfate as an adjuvant to local anesthetics in spinal anesthesia [3]. The biological basis for potential antinociceptive effect of magnesium is its voltage-dependent regulation of calcium influx into the cell, and noncompetitive antagonism of N-methyl-D-aspartate (NMDA) receptors [1].

Recent studies demonstrated that the magnesium sulfate as an adjuvant to bupivacaine in spinal anesthesia can play a beneficial role also in spinal anesthesia [7-9]. It acts by blocking N-methyl-D-aspartate (NMDA) channels in voltage dependent fashion and can prevent the induction of central sensitization by peripheral nociceptive stimulation [10].

Dexmedetomidine is agonist of alpha-2 adrenergic receptors used as adjuvants in epidural to increase the analgesic duration [11]. Dexmedetomidine is indicated for sedation of critically ill or injured patients in an intensive care unit setting [12]. It has also been used intravenously for postoperative pain relief as adjunct to epidural bupivacaine [13]. Intrathecal and epidural characteristics of

dexmedetomidine have been studied in animals [14,15]. In this study we aim to evaluate the efficacy of magnesium and dexmedetomidine as an adjuvant to epidural bupivacaine in lower limb surgery.

### MATERIALS AND METHODS

This prospective observational study was conducted in the department of Anaesthesiology, Integral Institute of Medical Science and Research, Lucknow, India. Total 60 patients with 24-57 years age, ASA grade I or II scheduled for elective lower limb surgeries were included in this study. Patients with chronic pain syndrome, history of analgesic use, history of adverse reaction to any study medication and neurologic disorders were excluded from the study. Informed written consent was obtained from all the participants after ethical approval from Institutional Ethical Committee.

All patients were divided into two groups of equal size on computer generated random table.

**Group (B+M):** Spinal anaesthesia with hyperbaric bupivacaine 15mg (3ml of 0.5%) + intrathecal 100mg magnesium sulfate

**Group (B+D):** Spinal anaesthesia with hyperbaric bupivacaine 15mg (3ml of 0.5%) + intrathecal 5.0 mcg dexmedetomidine

All patients were premedicated with ranitidine 150 mg, metoclopramide 10mg and alprazolam 0.25 mg orally, night before surgery. Every one of them was appropriately guided to make them mindful with respect to the way toward giving spinal anaesthesia. In the operation theatre (OT), all patients were associated with electrocardiogram, oxygen immersion (SpO<sub>2</sub>) and noninvasive pulse monitor and all the basal parameters were recorded and an IV line was gotten with 18 gauge cannula on the dorsum of hand and all patients were preloaded with 10-15 ml/kg of Ringer Lactate.

Lumbar cut was performed utilizing aseptic procedures in the sitting situation through the L4-L5 interspace in the midline utilizing 25-G Quincke needle, the tip of which was held corresponding to the dural filaments. At the point when clear cerebrospinal liquid was noticed, 15mg of 0.5% hyperbaric bupivacaine was controlled into the subarachnoid space. Every patient was then brought to the supine position and the operation table was held level with cushion under the head. Supplemental oxygen was given to each patient at 5litre/minute. Subsequent to continuing supine position the patients in group (B+M) got intrathecal mixture of magnesium sulfate in 100 normal saline and

group (B+D) got intrathecal mixture of dexmedetomidine in 100 ml normal saline. The rate infusion was kept at 10 macro drops/min in both study groups.

The heart rate, blood pressure and oxygen saturation were continuous monitor and recorded at every 5 min for first 30 min, at every 10 min for next 30 min and at every 15 min until the end of the surgery and during shifting in both groups, pre and intra-operatively. Hypotension has been characterized as systolic blood pressure >30% decline in baseline. In tachycardia, the heart rate >100/min and in bradycardia <60/min and these patient was treated with injection atropine 0.6 mg IV. Sensory block was assessed bilaterally by using analgesia to pin prick in midclavicular line. The time to reach the maximum level of sensory block and time for regression of two segments in the maximum block height was noted. Motor blockade was assessed by using Bromage scale (0: no motor block; 1: inability to raise extended legs; 2: inability to flex knees; 3: inability to flex ankle joints). The level of sensory and motor blockade was checked every 2 min until the maximum level of the block was achieved and at 5 min subsequently. The time for first analgesic requirement postoperatively or the time when the patient perceived pain for the first time following spinal anaesthesia was noted. Pain was assessed, using VAS (visual analogue scale) hourly for 24 hours. The complications such as hypotension, bradycardia, nausea, vomiting, shivering, and headache were recorded and treated accordingly.

**STATISTICAL ANALYSIS**

The study data was presented as mean±SD, number and percentage. All the categorical data will be compare by using chi square test. Continuous variables in two groups were compared by t- test. The p-value <0.05 was considered significant.

**RESULTS**

In this study total of 60 patients who underwent lower limb surgery were enrolled and randomly divided into two groups. The baseline characteristics of the patients of both groups are shown in Table 1. The mean age (years) weight (kg), height (cm), and BMI (kg/m<sup>2</sup>) were 38.73±9.14 and 36.87±9.04; 60.00±5.99 and 59.73±7.48; 164.20±6.40 and 165.13±7.21; 22.66±1.47 and 22.56±2.56 in group B+M and group B+D, respectively. The frequencies of male was 21(70%) and 17 (56.67%). Total 22 (73.33%) in group B+M and 21 (70.0%) in group B+D had ASA physical status. The baseline characteristics such as age (yrs), weight (kg), height (cm), BMI, sex and ASA physical status were not significantly different in between both groups.

**Table 1: Baseline characteristics of the both groups patients**

Characteristics	Group B+M (n=30)		Group B+D (n=30)		p value
	Mean	±SD	Mean	±SD	
Age (yrs)	38.73	9.14	36.87	9.04	0.430
Weight (kg)	60.00	5.99	59.73	7.48	0.879
Height (cm)	164.20	6.40	165.13	7.21	0.598
BMI (kg/m <sup>2</sup> )	22.66	1.47	22.56	2.56	0.853
Sex					
Males	21	70.00%	17	56.67%	0.422
Females	9	30.00%	13	43.33%	
ASA physical status					
I	22	73.33%	21	70.00%	0.775
II	8	26.67%	9	30.00%	

The characteristics of block characteristics between groups are shown in Table 2. The mean duration of onset time of sensory block at T10 (min.) was 8.57±1.96 and 6.60±1.61 in between group B+M and group B+D, respectively. The mean duration to maximum sensory block level (min.) was 14.82±2.23, and 13.53±1.53 in between group B+M and group B+D, respectively. The mean time in minutes for complete motor block (min.) was 19.07±2.29 and 16.57±1.50 in between group B+M and group B+D, respectively. The mean duration Motor Emergence from Bromage 3 (min.), Sensory Emergence and requirement of first time analgesia (min) were 176.10±68.44, 150.43±52.48 and 225.80±90.00 in group B+M and 223.67±71.37, 199.67±53.45 and 303.67±62.50 in group B+D, respectively. The mean Onset time of sensory block at T10 (min.), Time to maximum sensory block level (min.), Time in minutes for complete motor block (min.), Time for Motor Emergence from Bromage 3 (min.), Time for Sensory Emergence and Time for first analgesia (min) were significantly different between groups.

**Table 2: Comparison of block characteristics between groups**

Characteristics	Group B+M (n=30)		Group B+D (n=30)		p value
	Mean	±SD	Mean	±SD	
Onset time of sensory block at T10 (min.)	8.57	1.96	6.60	1.61	<0.001*
Time to maximum sensory block level (min.)	14.83	2.23	13.53	1.53	0.011*
Time in minutes for complete motor block (min.)	19.07	2.29	16.57	1.50	<0.001*
Time for Motor Emergence from Bromage 3 (min.)	176.10	68.44	223.67	71.37	0.011*
Time for Sensory Emergence	150.43	52.48	199.67	53.45	0.001*
Time for first analgesia (min)	225.80	90.00	303.67	62.50	<0.001*

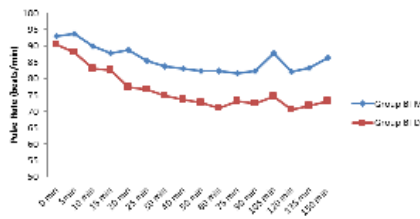
\*=Significant (p<0.05)

Table 3 shows the comparison of observed complication in both the groups during pre and post-operative duration. The frequencies of Hypotension, Bradycardia, Nausea, Vomiting and Shivering were 16.67%, 10.00%, 6.67%, 0.00%, and 6.67% in group B+M and group B+D, respectively. The incidences of these complications were comparable in between both the groups.

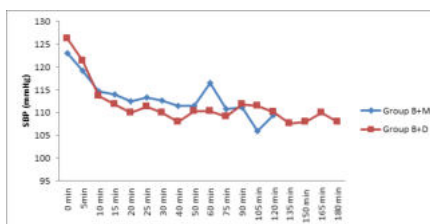
**Table 3: The comparison of observed complication in both the groups during pre and post-operative duration**

Complications	Group B+M		Group B+D		Chi-square	p-Value
	n	%	n	%		
Hypotension	5	16.67	2	6.67	0.64	0.421
Bradycardia	3	10.00	7	23.33	1.08	0.299
Nausea	2	6.67	3	10.00	0.22	0.640
Vomiting	0	0.00	0	0.00	-	-
Shivering	2	6.67	5	16.67	0.64	0.421

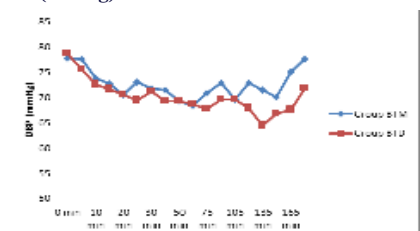
The perioperative haemodynamic such as heart rate, systolic blood pressure (SBP) and diastolic blood pressure (DBP) are shown in Fig. 1, Fig. 2 and Fig. 2. The mean heart rate, SBP and DBP of the patients were recorded at various time intervals, such as preoperatively, at 5 min intervals for first 30 min then 10 min intervals for 60 min and 15 min intervals up to 180 min. The heart rate was significantly lower in group B+D as compared to group B+M at perioperative 20 min. to 120 min. Moreover, the SBP and DBP were comparable during perioperative periods in between groups



**Fig. 1: Heart rate (beats/min.) at various time intervals in between groups**



**Fig. 2: SBP (mmHg) at various time intervals in between groups**



**Fig. 3: DBP (mmHg) at various time intervals in between groups**

## DISCUSSION

In humans, wide range of dose (1.5-2 µg/kg) of epidural dexmedetomidine is used. Previously various studies used 2 µg/kg to 1.5 µg/kg to epidural dexmedetomidine for postoperative analgesia [16,17]. Shahi et al. (2014) used smaller dose of 0.5 µg/kg of dexmedetomidine as an adjuvant to 14 ml of 0.5% epidural bupivacaine, significantly extended the motor and sensory block both [18].

In this study we observed that the mean time for onset of both sensory and motor block were significantly earlier in dexmedetomidine group as compared to magnesium sulfate group. Similarly, Jain et al., (2020) reported that the onset time of sensory and motor block were significantly earlier in dexmedetomidine (5 µg) group as compared to magnesium sulfate (75 mg) [19]. Our study was also supported by various previous studies in which they reported that the onset time of sensory block was significantly lower in dexmedetomidine group as compared to intrathecal magnesium [18,20-22]. Wapang et al. (2014) and Deepa et al. (2017) also reported the similar finding, they reported that the mean onset time of sensory and motor block were significantly faster in dexmedetomidine group as compared to magnesium group [23,24]. Shukla et al. (2011) shows that the motor block was significantly lower in dexmedetomidine (3.96 ± 0.92 min) as compared to to magnesium group took (7.18 ± 1.38 min) with bupivacaine [21]. Previous other studies also find the similar results, they reported that the onset of sensory and motor block was quicker in intrathecal dexmedetomidine (10µg) as compared to magnesium with hyperbaric bupivacaine [25-27]. The delayed onset of action in magnesium group may be due to alteration in pH and baricity of bupivacaine due to addition of MgSO<sub>4</sub>.

In this study we observed that the duration of sensory as well as motor block were prolong when added dexmedetomidine and magnesium an adjuvant to intrathecal bupivacaine, but prolongation was significantly greater dexmedetomidine group as compared to magnesium group. Similarly, Jain et al. (2020) and Shukla et al. (2011) observed that the duration of sensory and motor block times were patients significantly longer in dexmedetomidine group as compared to magnesium group [19,21]. Our study was also supported that Makhni et al. (2017), they reported that the sensory as well as motor block were significantly more in dexmedetomidine group as compared to magnesium group [20].

In our study the requirement of first rescue analgesia was significantly delay in dexmedetomidine as compared to magnesium group. Similar finding was observed by various previous studies, in which they reported that the mean duration of requirement of first rescue analgesia was significantly prolonged in dexmedetomidine group as compared to magnesium group [19,20,28-30]. In present study, both groups were haemodynamically stable. We did not observe any significant difference in complications such as hypotension, bradycardia, nausea, vomiting and shivering presented in Dexmedetomidine group and magnesium group.

## CONCLUSION

In this study we find that the dexmedetomidine as an adjuvant with hyperbaric bupivacaine leads to earlier onset and prolonged duration of both sensory and motor block and also prolonged the duration of analgesia with negligible hemodynamic changes and side effects as compared to magnesium sulfate as an adjuvant with hyperbaric bupivacaine in spinal anesthesia.

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