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Magnesium Sulphate and Dexmedetomidine used Intrathecally as Adjuvant to Bupivacaine: A Study

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ABSTRACT

Background: *Intrathecal adjuvants are used for prolongation of duration of subarachnoid block, and provide adequate analgesia.* ***Aim:*** *To evaluate the onset of sensory and motor block, level of sensory block, highest sensory level and Bromage grade at time of onset, induced by Dexmedetomidine and Magnesium sulphate when given intrathecally with 0.5% hyperbaric Bupivacaine for spinal anaesthesia.* ***Materials and methods:*** *90 patients, of ASA grade I and grade II, age 18-65 years, of either gender, height 150 cm and above and weight 50 kg to 80 kg, scheduled for lower abdominal and lower limb surgery under spinal anaesthesia. They were randomly assigned according to table of randomization into three groups, 30 patients in each group. Patients in Group A were given 15 mg hyperbaric Bupivacaine and 10 µg (0.1 ml) Dexmedetomidine and those in Group B were given 15 mg hyperbaric Bupivacaine and 50 mg (0.1 ml) magnesium sulphate. Patients in Group C were given 15 mg hyperbaric Bupivacaine and normal saline (0.1 ml) as control. The onset of sensory block, motor block, level of sensory and grade of motor block were recorded at the time of onset.* ***Results:*** *Onset of sensory and motor block was shorter in group Dexmed as compared to other two groups, and prolonged in group magnesium as compared to other two groups. The level of sensory block was higher at the time of onset and grade of motor block was more in group Dexmed than other two groups.* ***Conclusion:*** *Addition of Dexmedetomidine to Bupivacaine shortens the onset time whereas addition of Magnesium delays onset.*

Keywords: Dexmedetomidine, Magnesium sulphate, Bupivacaine, Spinal anaesthesia

INTRODUCTION

Spinal anaesthesia is the most common central block used in a surgical setting. The spinal technique is easy to perform and has a very high success rate. Spinal anaesthesia has been shown to blunt the stress response to surgery [1], decrease intraoperative blood loss [2], lower the incidence of postoperative thromboembolic events [3]. It can be used to extend analgesia into postoperative period, where its use has been shown to provide better analgesia than can be achieved with parenteral opioids [4]. Orthopaedic surgeries done under spinal anaesthesia have shown to reduce total blood loss by 30% to 50% [5]. Anaesthetic benefits of regional blocks are most evident in the postoperative phase. Residual block protects the patient from initial postoperative pain and requirement of opioids is reduced [6]. Regional anaesthesia has also been demonstrated to reduce perioperative mortality, pulmonary complications, risk of aspiration and deep vein thrombosis by 30% to 50% [7]. Many adjuvants have been used along with intrathecal hyperbaric Bupivacaine for analgesia, sedation, prolongation of block etc. In this study Dexmedetomidine and magnesium sulphate were compared for onset of regional anaesthesia.

Dexmedetomidine, a highly selective alpha-2 adrenoceptor agonist, is approved for short term sedation of mechanically ventilated patients [8]. It produces a unique type of sedation-analgesia with less ventilatory depression than commonly used sedative-hypnotics [9]. It is a valuable adjunct during surgery because of its anaesthetic and analgesic sparing effect and ability to decrease post-operative pain [10]. Unlike during opioid induced sedation, the hypercapnic arousal response, a feature of natural sleep, appears to be preserved during Dexmedetomidine sedation [8]. Its use is often associated with a decrease in heart rate and blood pressure [11], but they are dose dependent and predictable. In the spinal cord, activation of alpha 2-C and alpha 2-A receptors, present in superficial dorsal horn neurons [12], decrease pain transmission by reducing the release of neurotransmitter, substance P and glutamate from primary afferent terminals and by hyperpolarizing spinal interneurons via G-protein-mediated activation of potassium channels [13].

Magnesium is fourth most abundant cation in body and second intracellular cation [10]. Magnesium inhibits NMDA receptors by non-competitive means and prevents central sensitization from peripheral nociceptive stimulation. Magnesium can cause neuromuscular blockade by itself and potentiates neuromuscular blockade by both nondepolarizing and depolarizing muscle relaxants. The addition of magnesium sulphate to Bupivacaine in subarachnoid block improved postoperative analgesia in an orthopaedic setting [14]. The addition of magnesium sulphate to 2 ml 0.5 percent heavy Bupivacaine with 25 µg Fentanyl prolonged spinal anaesthesia in patients who underwent lower extremity surgery [15]. Magnesium sulphate has biphasic action on the onset of sensory and motor block, nevertheless the duration of spinal anaesthesia seems to be longer [16].

MATERIALS AND METHODS

After obtaining informed consent and approval from the institutional ethics committee the present double blinded study was conducted in the department of anaesthesiology and intensive care, Acharya Shri Chander College of Medical Sciences and Hospital, Jammu. The study included 90 patients, ASA grade I and grade II, age 18-65 years, of either gender, height 150 cm and above, and weight 50 kg to 80 kg, scheduled for lower abdominal and lower limb surgery under spinal anaesthesia. They were randomly assigned according to table of randomization into three groups, 30 patients in each group.

• Patients in Group A were given 15 mg hyperbaric Bupivacaine and 0.1 ml (10 µg) Dexmedetomidine.

• Patients in Group B were given 15 mg hyperbaric Bupivacaine and 0.1 ml (50 mg) magnesium sulphate.

• Patients in Group C were given 15 mg hyperbaric Bupivacaine and 0.1 ml normal saline as control.

Patients with a history of uncontrolled hypertension, allergy to the study drugs, contraindication for spinal anaesthesia, were excluded.

Complete preanesthetic check-up was done a day before surgery. All relevant investigations were done and the patient was kept fasting overnight. Tablet Pantoprazole 40 mg and tablet Midazolam 7.5 mg were advised at bed time on night before surgery.

In the recovery room, an intravenous line with appropriate cannula was established. Each patient was given 10 ml per kg infusion of Ringer's lactate before surgery. The non-invasive monitors were attached to the patient and baseline vitals noted. The patient was placed in sitting position. Under all aseptic precautions skin overlying L3-L4 interspace was infiltrated with 2 ml of 2% Xylocaine. Drug was injected in subarachnoid space by using 25G Quincke spinal needle. Throughout the procedure, the patient received oxygen 3 L/min through ventimask. The following observations were made. Onset of sensory block was assessed bilaterally in midclavicular line by assessing the changes in pinprick sensation with hypodermic needle every two minutes till no sensation (Grade 2) was achieved [Graded according to Gromley and Hill - 1996]. Normal sensation - 0, blunted sensation - 1, no sensation - 2. Grade 2 was taken as onset of sensory block. Onset of motor block was assessed every two minutes till complete motor block (Grade 3) was achieved [Graded according to modified Bromage scale] in the limbs. Grade 0 - no motor block, Grade 1 - inability to raise extended legs, Grade 2 - inability to flex knees, Grade 3 - inability to flex ankle joints, and grade 3 was taken as complete motor block. Intra-operative non-invasive monitoring of vitals (HR, SBP, DBP and SPO_2) was done every two minutes for first ten minutes, every five minutes for next fifteen minutes and every fifteen minutes there after till the completion of surgical procedure.

Side effects

Hypotension (categorized as fall in SBP to less than 90 mmHg or decrease in MBP of more than 20% from base line), bradycardia (decrease in heart rate greater than 20% from baseline), nausea/vomiting, headache, backache

RESULTS

There was no significant difference in demographic data in three groups, $p>0.05$. Onset of sensory and motor block were rapid in group Dexmed as compared to other two groups, and delayed in group magnesium as compared to other two groups. The results were statistically insignificant with $p>0.05$ (Table 1).

Table 1 Onset of sensory and motor block (Time in minutes)

Group	Onset of sensory block	Onset of motor block
Group A	2.27 ± 0.69	3.60 ± 1.22
Group B	3.4 ± 1.30	4.87 ± 1.36
Group C	3.27± 1.11	4.33 ± 1.40
P value	0.87	0.909
Remarks	NS	NS
NS: Non-significant		

The level of sensory block was high in maximum number of patients in group Dexmed at the time of onset as compared to other two groups. On comparing the results were found statistically significant ($p<0.05$) (Table 2).

Table 2 Comparison of onset of sensory block (level of dermatome)

Group	Level of onset of sensory block					
	L1	L2	L3	L4	L5	S1
A	4 (13.33%)	4 (13.33%)	7 (23.67%)	4 (13.33%)	6 (20%)	5 (16.67%)
B	0	3 (10%)	4 (13.33%)	4 (13.33%)	6 (20%)	13 (43.33%)
C	0	2 (6.67%)	3 (10%)	5 (16.67%)	8 (26.67%)	12 (40%)
P=0.00000001; Remarks: HS Highly Significant						

The highest sensory level (level of dermatome) was high in maximum number of patients in group Dexmed as compared to other two groups. On comparing the results at T5 and T6 dermatomes, the difference was statistically insignificant, whereas the comparison of results at T7 dermatome was found statistically significant (Table 3).

Table 3 Comparison of peak sensory level achieved (level of dermatome)

Group	Peak sensory level (thoracic segment %)				
	4	5	6	7	8
A	5 (16.67%)	9 (30.00%)	13 (43.33%)	3 (10.00%)	0
B	0	9 (30.00%)	11 (36.67%)	8 (26.67%)	2 (6.67%)
C	0	10 (33.33%)	16 (53.33%)	4 (13.33%)	0
p-Value	-	0.887	0.205	0.045	-
Remarks	-	NS	NS	S	-
NS: Non-Significant; S: Significant					

The Bromage grade for motor blockade at the time of onset was high in maximum number of patients in group Dexmed as compared to other two groups. On comparing the results were found statistically insignificant ($p>0.05$) (Table 4).

Table 4 Comparison of onset of motor block (Bromage grade)

Group	Level for onset of sensory block	
	B1	B2
D	24 (80%)	6 (20%)
M	28 (93.33%)	2 (6.67%)
C	27 (90%)	3 (10%)
p=0.072; Remarks: NS; NS: Non-significant		

DISCUSSION

Onset of sensory block in group Dexmed was rapid (2.27 ± 0.69 min), and level (dermatome) of block, at the time of onset of sensory block, was higher in group Dexmed as compared to other two groups, and comparable in group magnesium and group control. Al-Mustafa et al. [17], found that the onset of sensory block was rapid when Dexmedetomidine 5 µg was added to 12.5 mg of hyperbaric Bupivacaine. Onset of motor block was rapid (3.60 ± 1.22 min), and Bromage grade was higher in group Dexmed at the time of onset of motor block. Similar results were found by Shukla, et al. [18], in their study in which they found that onset of block was rapid and of prolonged duration in the group Dexmed. The level of sensory block on an average was high in group Dexmed compared to other two groups.

On the other hand, magnesium delayed the onset of both sensory (3.40 ± 1.30 min) and motor block (4.87 ± 1.36 min). The level (dermatome) of sensory block was low at the time onset. The highest sensory level achieved was low compared to group Dexmed. Ozalevli et al. [19], found that with addition of magnesium sulphate to Bupivacaine and Fentanyl during subarachnoid block using 25 µg Fentanyl with 50 mg magnesium sulphate onset of both sensory and motor blockade was delayed but duration was prolonged without significant side effects.

CONCLUSION

Based on this study, it is concluded that intrathecal Dexmedetomidine as adjuvant to spinal block seems to be superior than intrathecal magnesium sulphate as it produces earlier onset and peak sensory block without associated significant haemodynamic alterations.

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