

# A Comparative Study using Two Different Doses of Magnesium Sulfate as Adjuvant to Intrathecal Hyperbaric Bupivacaine for Lower Segment Cesarean Section

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## Abstract

**Introduction:** Adequate analgesia following cesarean section decreases morbidity and ambulation, improves patient outcome, and facilitates care of the newborn baby. Intrathecal (IT) magnesium an N-methyl-D-aspartate antagonist has been shown to prolong analgesia without significant side effect in the healthy parturient.

**Aim:** The aim is to study the effects of two different doses of IT magnesium sulfate 50 mg and 100 mg as an adjuvant to 0.5% hyperbaric bupivacaine 9 mg in elective lower segment cesarean section.

**Materials and Methods:** A total of 60 patients with the American Society of Anesthesiologists I and II between the age groups of 18 and 35 undergoing elective cesarean section under spinal anesthesia were randomly divided into three groups. Group S: 0.2 ml containing normal saline was added, Group M1: 0.2 ml containing 50 mg magnesium sulfate was added, and Group M2: 0.2 ml containing 100 mg sulfate was added.

**Results:** Onset of sensory and motor blockade was delayed in the magnesium sulfate group. Duration of spinal anesthesia and motor block duration are prolonged in magnesium sulfate group (189.40 min). Post-operative analgesia was significantly prolonged in the magnesium sulfate group when compared to control group (403.65 vs. 222.45 min).

**Conclusion:** There is a delay in the onset of sensory and motor blockade with the use of magnesium sulfate. However, there is prolonged motor blockade and duration of analgesia overlaps well into the post-operative period. This is beneficial for the patient for post-operative analgesia. APGAR score was not affected in the groups.

**Key words:** Bupivacaine, Magnesium sulfate, Pregnancy-induced hypertension

## INTRODUCTION

Spinal anesthesia is commonly used for the cesarean section due to avoiding the risks of general anesthesia, allowing a parturient to remain awake and enjoy the birthing experience.<sup>[1]</sup> The quality and duration of sensory

and motor block and decreased postoperative pain are important in the cesarean section and patient's content satisfaction. Opioids and other drugs such as clonidine and neostigmine were added to local anesthetics to this purpose, but significant side effects, such as pruritus, respiratory depression, nausea, and vomiting, may limit their use.<sup>[2]</sup> Central sensitization is an activity-dependent increase in the excitability of spinal neurons and is considered to be one of the mechanisms implicated in the persistence of post-operative pain.<sup>[3]</sup>

Magnesium sulfate blocks the N-methyl-D-aspartate (NMDA) channels in a voltage-dependent way to improve the quality and duration of the spinal block.<sup>[4]</sup> However,

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the use of magnesium sulfate safety profile has been documented by histopathological analysis in experimental studies.<sup>[5]</sup> Systemic delivery of magnesium sulfate decreases post-operative opioid requirements.<sup>[6,7]</sup> In experimental studies, spinal injection of magnesium sulfate reduces the respond to painful stimulus in rats.<sup>[8]</sup> Magnesium sulfate ordered together with fentanyl in other surgeries with different doses in spinal anesthesia (in human) and delivery painless, but there are no enough studies for the cesarean section.<sup>[9]</sup>

### Aim

The aim is to study the effects of two different doses of intrathecal (IT) magnesium sulfate 50 mg and 100 mg as an adjuvant to 0.5% hyperbaric bupivacaine 9 mg in elective lower segment cesarean section.

## MATERIALS AND METHODS

This study was conducted in the Department of Anesthesiology at Tirunelveli Medical College. 60 pregnant women of the physical status American Society of Anesthesiologists (ASA) I and II between the age groups of 18 and 35 posted for elective lower segment cesarean section were selected for the study. The patients were randomly allocated into three groups comprising 20 patients in each group.

### Inclusion Criteria

The following criteria were included in the study:

1. ASA physical status I and II
2. Age between 18 and 35 years
3. At term, elective cesarean section
4. Valid informed consent
5. Pregnant women with the height ranging between 145 and 180 cm
6. Pregnant women with weight ranging between 50 and 90 kg.

### Exclusion Criteria

The following criteria were excluded from the study:

1. Pregnant patients are having coexisting systemic disorders such as neuromuscular diseases, neuronal degenerative disorder, seizure disorder, bleeding and hematological disorders, cardiac disorders, diabetes mellitus, or gestational diabetes
2. Pregnant women with hepatic and renal disorders, severe anemia
3. Eclampsia
4. Parturient in active labor, twin/complicated pregnancy
5. Spinal deformities, poliomyelitis short stature <145 cm
6. Weightless than 50 kg and >90 kg
7. Patient refusal, contraindications to spinal anesthesia, allergy to local anesthetic drugs

8. Fetal distress
9. Mentally retarded.

Each patient will be reassured, explained the procedure, and informed consent taken. All patients will be confirmed to be physically fit. Minimal fasting period was 8 h, IV line secured with 18G venflon are given aspiration prophylaxis comprising of injection metaclopramide (10 mg) and ranitidine (50 mg) IV 10 min before surgery and preloaded with RL 10–12 ml/kg. Subarachnoid block was instituted at L3–L4 or L4–L5 intervertebral space in right Lateral with 1.8 ml 0.5% hyperbaric bupivacaine (9 mg) and one of the adjuvant of 0.2 ml as per designated group shown below:

- Group S: 0.2 ml containing normal saline was added
- Group M1: 0.2 ml containing 50 mg magnesium sulfate was added
- Group M2: 0.2 ml containing 100 mg sulfate was added.

Thus, each group comprising 20 patients will be given IT bupivacaine and a group-wise adjuvant which will be thoroughly and properly mixed to make up the volume of 2 ml. All patients received O<sub>2</sub> 4 L/min through face mask throughout the procedure. Patients were treated with titrated doses of ephedrine 6 mg intravenous (I.V.) if systolic BP < 100 mm/Hg or <20% baseline and atropine 0.6 mg I.V. if heart rate <50/min. After delivery of baby, injection Oxytocin 10 IU in drip and 10 IU Im were given.

Heart rate, respiratory rate, electrocardiogram, peripheral oxygen saturation monitored, and no invasive blood pressure were recorded every 2 min for first 10 min and every 5 min until the end of surgery and every 30 min in the post-operative period. APGAR score of neonate assessed at birth and 5 min. The neonate will be assessed by a pediatrician to rule out any depressive action by the usage of magnesium sulfate. Side effects and complications if any were recorded and treated concurrently.

## RESULTS

Sixty pregnant patients of ASA I and II undergoing elective cesarean section under spinal anesthesia after obtaining informed consent were selected. Sensory and motor block onset time, the upper level of analgesia, duration of analgesia and motor blockade, and APGAR score hemodynamics between the groups were evaluated. In our study, sensory block onset time in the magnesium sulfate group is 1.03 min compared to the control group (0.54 min) which is statistically significant ( $P < 0.001$ ) Figure 1. Onset time of sensory and motor block was shorter in Groups C and M<sub>1</sub> than others ( $P < 0.001$ ). Resolution of sensory and

motor block was significantly longer in our groups than others ( $P < 0.001$ ) Figure 2. The onset of motor block in the magnesium sulfate group is 9.15 min when compared to control group (3.31 min) which is statistically significant ( $P = 0.000$ ). Hence, there is a delay in the onset of motor block Figure 3.

The intensity of motor block in magnesium sulfate group is 2.25 and in control group is 95, which is statistically less significant ( $P = 0.291$ ). Analgesic and motor block duration is prolonged in magnesium sulfate Group  $M_2$  (189.40 min) when compared to the control group which is statistically highly significant ( $P = 0.000$ ) Figure 4. Fall in blood pressure and requirement of

ephedrine are more in the control group (17.35 mg) compared to magnesium sulfate groups  $M_2$  (8.55 mg) ( $P = 0.000$ ) which is highly significant due to a high level of blockade Figures 5 to 9. Duration of post-operative analgesia - Duration is prolonged in magnesium sulfate group  $M_2$  (403.65 min) when compared with control group (222.45), which is statistically highly significant ( $P = 0.000$ ). There is no difference in APGAR score 1 min and 5 min between the groups ( $P = 0.204$  and  $0.073$ ), respectively, statistically insignificant Figures 10 and 11. Two patients due to inadequate blockade converted to GA were excluded from the study.

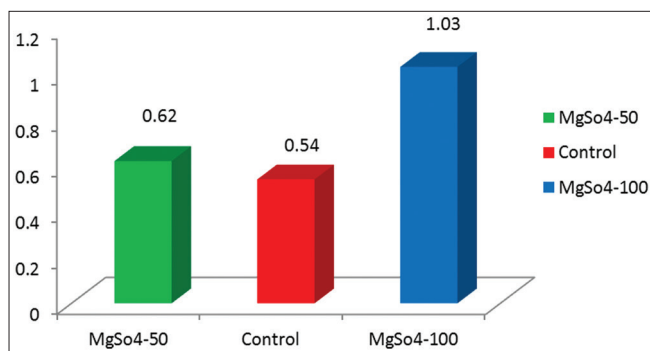


Figure 1: Distribution of sensory block onset time

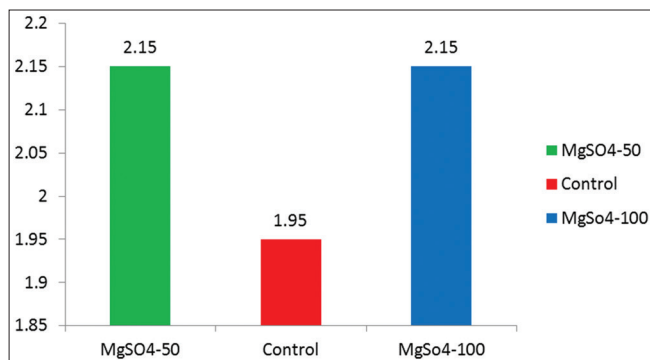


Figure 2: Distribution of onset and intensity of motor block

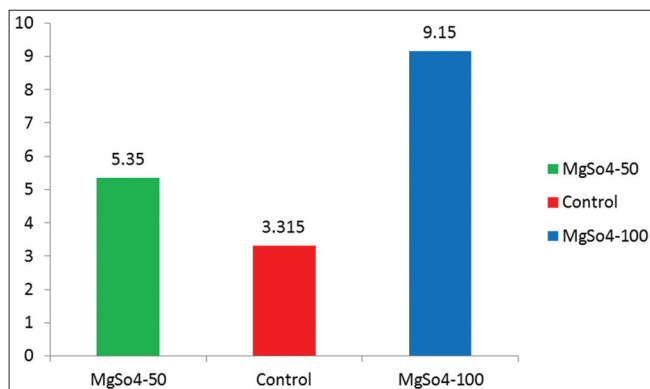


Figure 3: Distribution of motor block onset time

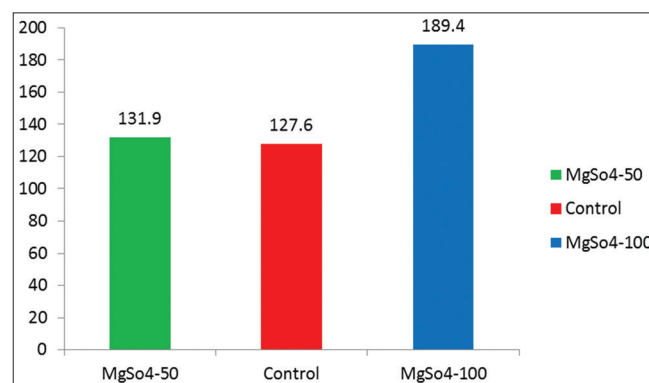


Figure 4: Distribution of analgesic and motor block duration

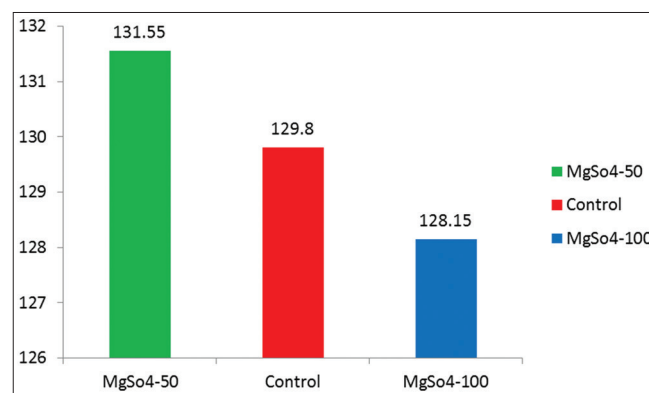


Figure 5: Distribution of systolic pressure in 1 min

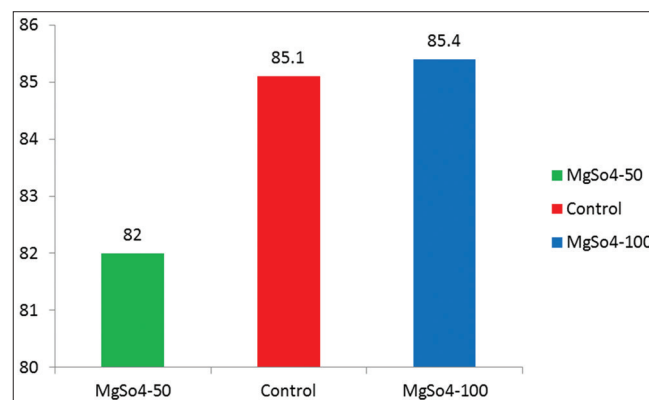


Figure 6: Distribution of diastolic pressure in 1 min

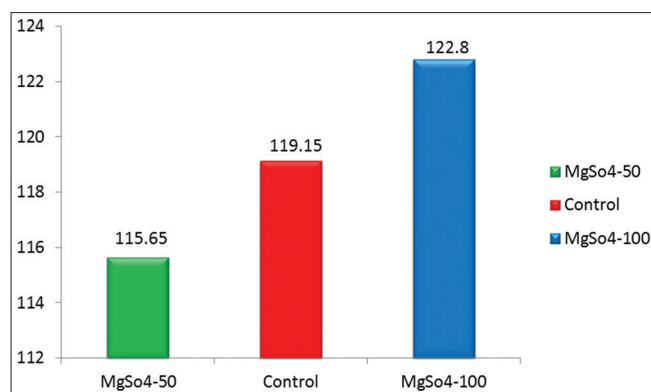


Figure 7: Distribution of systolic pressure in 5 min

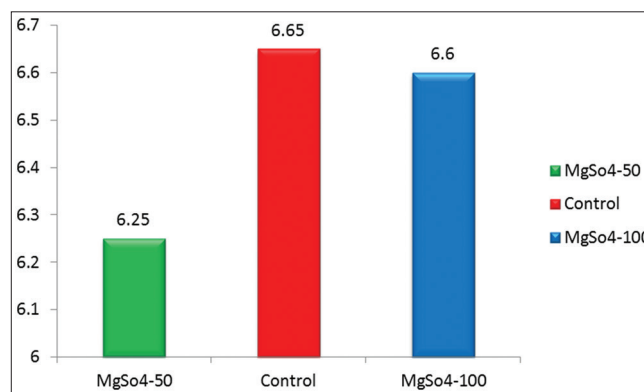


Figure 10: Distribution of APGAR score in 1 min

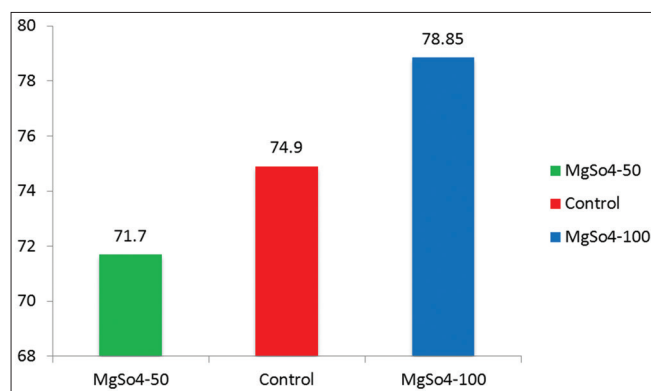


Figure 8: Distribution of diastolic pressure in 5 min

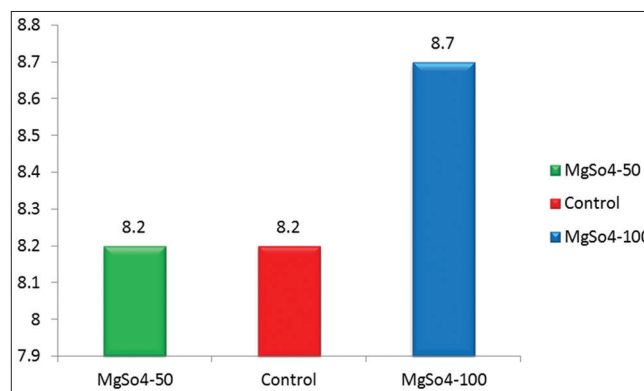


Figure 11: Distribution of APGAR score in 5 min

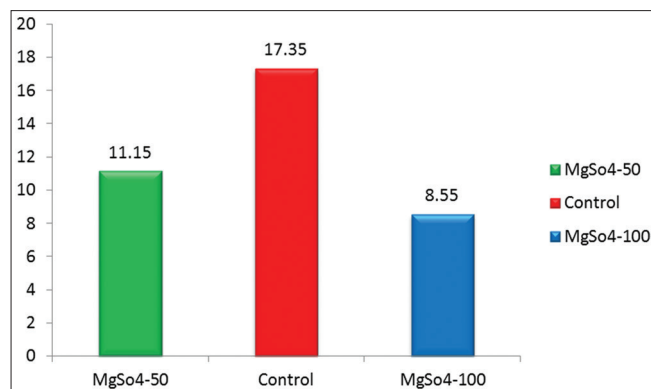


Figure 9: Distribution of ephedrine requirement

## DISCUSSION

Magnesium sulfate is an intracellular cation with various physiologic functions such as enzyme activation, nerve signal conduction, and protein synthesis and vasomotor tonicity regulation. Magnesium sulfate has been used in various clinical situations including preeclampsia, tocolysis, arrhythmias, myocardial ischemia, bronchial asthma, and post-operative shivering.<sup>[10,11]</sup> Magnesium sulfate acts as an antagonist of calcium channels and non-competitive antagonist at NMDA receptors.<sup>[12,13]</sup> It appears that, with this property, magnesium sulfate acts as a preventive

analgesic and may have a role in the prevention of post-operative pain.<sup>[14,15]</sup> Many studies with various designs and methods about the effects of magnesium sulfate on post-operative pain have shown varied outcomes.<sup>[16,9]</sup>

The dose of magnesium used in this study was based on data from Buvanendran *et al.*<sup>[9]</sup> where 50 mg of spinal magnesium sulfate potentiated fentanyl antinociception. Larger doses have also been used. In 1985, Lejuste.<sup>[17]</sup> described the inadvertent IT injection of 1000 mg of magnesium sulfate, producing a dense motor block followed by complete resolution within 90 min, with no neurological deficit at long-term follow-up. Further examination is required to determine whether larger doses of magnesium produce greater potentiation of spinal analgesia without causing any neurological deficit when injected intrathecally.

The efficacy and safety of IT magnesium sulfate were reported in rats and human in earlier studies. In rats, boluses of magnesium sulfate produced transient motor and sensory block with no opposed clinical or histological results.<sup>[18]</sup> In a randomized, controlled canine study, no neurological deficit or change in cord histopathology was reported following IT magnesium administration (45–60 mg).<sup>[19]</sup> A recent human study found no harmful

effects of IT magnesium on spinal opioid analgesia in labor.<sup>[9]</sup> Thus, IT magnesium sulfate seems to have a good safety profile.

## CONCLUSION

There is a delay in the onset of sensory and motor blockade with the use of magnesium sulfate group. However, there is prolonged motor blockade and duration of analgesia overlaps well into the post-operative period. This is beneficial for the patient for post-operative analgesia. APGAR scores was not affected in the groups.

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