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## Effect of adding magnesium sulfate to local anesthetics during spinal anesthesia for cesarean section: A random double-blind assessment

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### Abstract

**Background:** The quality and duration of sensory and motor block and decrease postoperative pain is important in the caesarean section and patient's content satisfaction. Opioids, clonidine, neostigmine and magnesium sulfate were added to local anesthetics in spinal anesthesia in trials to improve anesthetics performance.

**Aim of the study:** The aim of this study was to investigate the effect of adding 75 mg of magnesium sulfate on the duration of sensory block and duration of motor block.

**Patients and methods:** In a double-blind randomized clinical trial, ASA I or II, 64 (32 control and 32 experimental groups) pregnant women (at term) who were candidate for cesarean section with spinal anesthesia, were recruited in this study. They were collected from "Medical City Teaching Hospital" (October 2018 – January 2018).

Each experimental woman received 12.5 mg (2.5 ml) of hyperbaric bupivacaine (0.5%) and 0.5 ml (75 mg) magnesium sulfate (15%), while controls received same does of hyperbaric bupivacaine and 0.5 ml of distilled water.

Response to treatment was assessed as onset of anesthesia, time of end of surgery, duration of sensory block and time of complete recovery.

**Results:** Results revealed that the duration of analgesia (sensory blockade) and the duration of motor blockade manifested a statistically significant increase in experimental as compared to their controls (control =  $116.41 \pm 12.47$ , experimental =  $159.75 \pm 10.56$ , control =  $180.76 \pm 11.83$ , experimental =  $240 \pm 9.46$  minutes respectively).

**Conclusion:** The addition of 75 mg of magnesium sulfate to hyperbaric bupivacaine in spinal anesthesia for cesarean section had significantly increased the duration of postoperative analgesia and prolonged the sensory and motor blockade without significant apparent maternal or fetal side effects.

**Keywords:** Spinal anesthesia, bupivacaine, magnesium sulfate, cesarean section

### Introduction

Spinal anesthesia, also called spinal analgesia (because it can be used as a post lower limbs operations analgesia), spinal block or sub-arachnoid block (SAB), is a form of regional anesthesia involving injection of a local anesthetic into the subarachnoid space, generally via a fine needle through intervertebral foramen (L4 –L5) [1].

Baricity plays an important role in determining the spread of local anesthetic in the spinal space and is equal to the density of the local anesthetic divided by the density of the CSF at 37 °C (2,3,4). Local anesthetics can be hyperbaric, hypobaric, or isobaric when compared to CSF, and baricity is the main determinant of how the local anesthetic is distributed when injected into the CSF [2, 4, 5].

Spinal anesthesia is commonly used for the cesarean section to avoid the risks of general anesthesia, allowing a parturient to remain awake and enjoy the birthing experience. The quality and duration of sensory and motor block and decrease postoperative pain is important in the cesarean section and patient's content satisfaction. Opioids and other drug 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 [6]. Magnesium sulfate was added to local anesthetics too for the same purpose. In experimental studies, spinal injection of magnesium sulfate reduces the response to painful stimulus in rats [7]. On the other hand, magnesium sulfate potentiates morphine anti-nociception at the spinal level [8].

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### Aim of the study

The aim of this study was to investigate the effect of adding 75 mg of magnesium sulfate (to hyperbaric bupivacaine) on the duration of sensory and motor blockade.

### Patients and methods

This study was performed after the approval of the Iraqi Council for Medical Specialization in anesthesia and intensive care, and after obtaining their consents from the patients. In a double-blind randomized clinical trial, 64 pregnant women (at term) who were candidate for cesarean section with spinal anesthesia were recruited in this study (January 2018 - October 2018). Patients were randomly selected and allocated into two groups: control group (32 patients) and experimental group (32 patients).

### The inclusion criteria were

1. Age (17-40) years
2. Height (151 - 170) cm
3. Weight (57 - 78) kg
4. ASA class I or II.

### The exclusion criteria were

1. Regional anesthesia refusal
2. Absolute contraindication of spinal anesthesia
3. Complicated pregnancy

### Dosing

After obtaining their consent and explaining the full details of the study. Each experimental woman received 12.5 mg (2.5 ml) of hyperbaric bupivacaine (0.5%) and 0.5 ml (75 mg) magnesium sulfate (15%), while controls received same dose of bupivacaine and 0.5 ml of distilled water.

### Procedures

From each patient, full history was taken and weight, height and age were calculated. I.V. access was established and 1L of normal saline (0.9%) was administered as preload fluid. Lumbar puncture was performed in the sitting position. A 25 gauge (pencil point, Braun, Melsungen, Germany) spinal needle was introduced into the subarachnoid space at the L4 - L5 lumbar level midline approach with the needle orifice cephalad. After free flow of cerebrospinal fluid out of the needle, the ready fluid hyperbaric bupivacaine (Astra Zenika, Sweden) added with magnesium sulfate was injected to subarachnoid space of the experimental group and hyperbaric bupivacaine with distilled water was injected to controls. The spinal needle was withdrawn and patients were positioned supine. No additional analgesic was administered. Maximum sensory level attained was comparable in both groups between T6 and T8. Systolic and diastolic blood pressure and level of consciousness were recorded in the base line and every 3 min. In addition, SPO<sub>2</sub> and heart rate was monitored throughout the operation.

### Each patient, from control and experimental groups, were monitored by recording

1. The time of onset of anesthesia (TO)
2. The time of end of surgery (TES)
3. The time of analgesia requirement (TAR)
4. The time of complete recovery (CR)

The duration of sensory block and duration of spinal anesthesia were calculated. The duration of sensory block

was defined as the period from the onset of anesthesia to the first occasion when the patient complained of pain in the postoperative period. The discharge criteria to the ward were stable signs of blood pressure, pulse rate and SPO<sub>2</sub>, and the patient should be pain free, and do not have nausea and vomiting. Finally, the haemodynamic parameters in the intra- and post-operative period were monitored. Moreover, the side effects during anesthesia and in recovery was recorded, for mothers and fetuses.

### Statistical analysis

Data were analyzed using SPSS (statistical package for social sciences) version 23. Descriptive statistics as mean  $\pm$  standard deviation. Student - T - test was employed for comparison between control and experimental groups. All statistical analysis level of significance was set at P value equal or less than 0.05 to be considered as significant difference.

### Results

#### General notes

The haemodynamic parameters in the intra- and post-operative period were relatively similar in both groups.

The side effects during anesthesia and in recovery, such as nausea, vomiting, headache and dyspnea and side effects during surgery such as hypotension were relatively lower in experimental group than controls although not statistically significant. No neurological deficits or other complication was observed in any patient of both groups.

#### Age, height and weight

The age, height and weight of control and experimental patients (the 64 patients who were included in this study) are summarized in table (1), (2) and (3) respectively.

There was no significant difference among the groups with respect to age, height and weight.

**Table 1:** the age of the patients involved in this study

|              | Range   | Mean $\pm$ SD    | No. of patients |
|--------------|---------|------------------|-----------------|
| Control      | 17 - 39 | 26.47 $\pm$ 5.65 | 32              |
| Experimental | 20 - 35 | 26.16 $\pm$ 4.43 | 32              |
| Total        |         |                  | 64              |

P value = 0.237

**Table 2:** the height of control and experimental patients

|              | Range   | Mean $\pm$ Sd    | No. of patients |
|--------------|---------|------------------|-----------------|
| Control      | 60 - 87 | 69.69 $\pm$ 3.99 | 32              |
| Experimental | 57 - 84 | 68.97 $\pm$ 5.98 | 32              |
| Total        |         |                  | 64              |

P value = 0.523

#### Duration of surgery

The range and mean of time of surgery is summarized in table (Table 3). With respect to time of surgery, there was no significant difference between control and experimental groups.

**Table 3:** duration of surgery in control and experimental groups

|                    | Mean (minutes) $\pm$ SD | No. of patients |
|--------------------|-------------------------|-----------------|
| Control group      | 58.15 $\pm$ 13.10       | 32              |
| Experimental group | 59.10 $\pm$ 18.51       | 32              |
| Total              |                         | 64              |

SD = Standard deviation

P value = 0.808

**Duration of analgesia (duration of sensory blockade)**

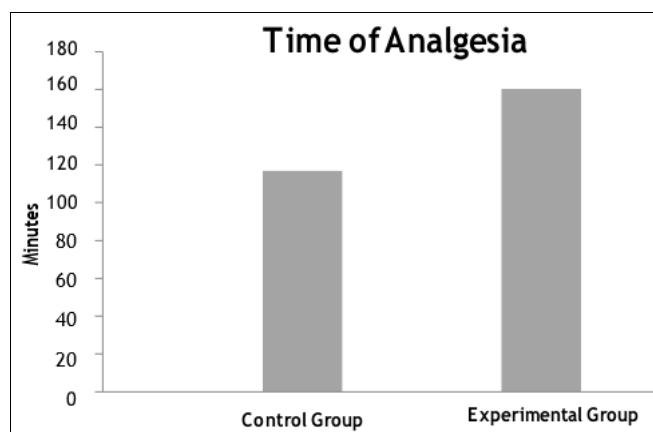
The range of duration of analgesia, in controls, was (80 – 145) minutes and its mean was 116.41, while the range in the experimental group was (115 – 190) with mean of 159.75 (Table 4). The mean duration of experimental group revealed a statistically significant increase when compared with that of controls (P value = 0.041543).

**Table 4:** the duration of analgesia in control and experimental groups

|                    | Mean (minutes) $\pm$ SD | SE   | No. of patients |
|--------------------|-------------------------|------|-----------------|
| Control group      | 116.41 $\pm$ 9.47       | 3.51 | 32              |
| Experimental group | 159.75 $\pm$ 7.56       | 4.29 | 32              |
| Total              |                         |      | 64              |

SD = Standard deviation SE=Standard error

P value = 0.041543 (statistically significant)



**Fig 1:** Bar diagram showing the time of analgesia in control and experimental groups

**Duration of Complete recovery (time of motor blockade)**

The range of the time of complete recovery was (130 – 230), while its mean was 180.76. On the other hand, the range the experimental group was (165 – 275) and its mean was 240 (Table 5). The increase of the time of recovery was statistically significant (P value = 0.0315).

**Table 5:** The Duration of complete recovery in control and experimental groups

|                    | Mean $\pm$ SD      | SE   | No. of patients |
|--------------------|--------------------|------|-----------------|
| Control group      | 180.76 $\pm$ 11.83 | 4.60 | 32              |
| Experimental group | 240 $\pm$ 9.46     | 3.68 | 32              |
| Total              |                    |      | 64              |

SD = Standard deviation SE = Standard error

P value = 0.0315 (Statistically significant)

**Discussion****Duration of analgesia (Duration of sensory block)**

Few trials were done to increase the time of analgesia and anesthesia by adding different doses of magnesium sulfate to the local anesthetics. Shoeibi and his coworkers, recorded an increase in duration of analgesia after adding 50 mg magnesium sulfate to lidocaine spinal anesthesia [9]. Moreover, Manjula and colleagues disclosed that addition of 50mg of magnesium sulfate to 2.4 ml of 0.75% of isobaric Ropivacaine spinal anesthesia prolongs the duration of sensory and motor blockade [10]. Furthermore, Buvenendran and colleagues found that Intrathecal magnesium prolonged (20  $\mu$ ) fentanyl analgesia [11]. However, Mitra and Sayed found that adding 100mg of magnesium sulfate to

hyperbaric bupivacaine prolongs the duration of analgesia, while 50 mg of magnesium sulfate didn't do it. [12] On the other hand, Khalili and his coworkers arrayed that In patients undergoing lower extremity surgery with spinal anesthesia, the addition of 100 mg magnesium sulfate to 15 mg bupivacaine without opioid supplement, prolonged the duration of the sensory block, decreased postoperative analgesic consumption, and significantly prolonged the onset of spinal anesthesia [13]. All the above mentioned investigations agreed that magnesium sulfate revealed a statistically significant increase in the duration of anesthesia, and this coincides with the outcome of this study. However, the dose of magnesium sulfate that causes this statistically significant prolongation of the analgesia was controversial. All agreed that adding 100 mg of magnesium sulfate leads to a significant prolongation of sensory blockade [12, 13], yet 75 mg and 50 mg disclosed significant and nonsignificant outcomes [9, 10, 12].

**Duration of anesthesia (duration of motor block)**

The significant prolongation of motor blockade that is elicited in this investigation coincides with previous studies. [10, 12] However, other studies found that adding magnesium sulfate to bupivacaine and fentanyl was not effective [14, 15].

**Conclusions and recommendations**

The addition of 75 mg of magnesium sulfate to hyperbaric bupivacaine in spinal anesthesia for cesarean section had significantly increased the duration of postoperative analgesia and prolonged the sensory and motor blockade without significant apparent maternal or fetal side effects.

**Recommendations**

Magnesium sulfate is recommended to be used in spinal anesthesia for cesarean section. However, further studies should be directed towards

1. Study of the effect of adding different doses of magnesium sulfate to local anesthesia to fix the minimum effective dose
2. Study the effect of adding magnesium sulfate to a large number of patients
3. Compare the effect of adding magnesium sulfate with adding opioids to local anesthetics
4. Study the effect of adding magnesium sulfate to different types of local anesthetics

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