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ORIGINAL ARTICLE

# The effect of adding magnesium sulphate to epidural bupivacaine and fentanyl in elective caesarean section using combined spinal–epidural anaesthesia: a prospective double blind randomised study

A.A. Yousef, Y.M. Amr
*Department of Anesthesia, Faculty of Medicine, Tanta University, Tanta, Egypt*

**ABSTRACT**
**Background:** Combined spinal–epidural anaesthesia is commonly used for elective caesarean section. Intrathecal injection produces rapid onset with minimal doses of local anaesthetic and epidural administration can be used to prolong the block. Our study examined the effects of adding magnesium sulphate to epidural bupivacaine and fentanyl in patients undergoing elective caesarean section using combined spinal–epidural anaesthesia.
**Methods:** Women ASA physical status I or II at term were recruited. All received 2 mL intrathecal 0.5% hyperbaric bupivacaine, 10 mL epidural 0.25% plain bupivacaine with fentanyl 100 μg, and were randomly allocated to receive either 10 mL of epidural 0.9% sodium chloride or 10 mL epidural 5% magnesium sulphate. The quality of surgical anaesthesia, incidence of hypotension, Apgar scores, intraoperative pain assessment, onset of postoperative pain, sedation scores and side effects were recorded in the postoperative period.
**Results:** Ninety women were recruited. There was no difference in the time taken for the block to reach T4 sensory level, time to reach the highest level of sensory block, time interval between first neuraxial injection and onset of surgery between the groups. Women who received magnesium had greater motor block and muscle relaxation ($P < 0.05$). Apgar scores were 7 or more in almost all neonates in both groups. There was no significant difference in the incidence of hypotension, nausea and vomiting and duration of motor blockade between the groups. Women who received magnesium showed less shivering and later onset of post operative pain ($P < 0.05$).
**Conclusion:** The addition of magnesium to epidural bupivacaine and fentanyl in women undergoing elective caesarean section with combined spinal–epidural anaesthesia improved intraoperative conditions and the quality of postoperative analgesia.


***Keywords***: Combined spinal–epidural anaesthesia; Epidural magnesium sulphate; Caesarean section

## Introduction

Regional anaesthesia is preferred for caesarean section since it allows a parturient to remain awake and participate in the birth of her baby whilst avoiding the risks of general anaesthesia.[1] The combined spinal–epidural (CSE) technique is frequently used to provide anaesthesia and analgesia for labour and delivery.[2] To improve the quality of intraoperative anaesthesia, postoperative analgesia and aid early ambulation and recovery of motor block, several agents have been employed such as opioids and *n*-methyl *d*-aspartic acid (NMDA) receptor antagonists.[3] The latter prevent central sensitisation induced by peripheral nociceptive stimulation by blocking dorsal horn NMDA receptor activation.[4] Magnesium has antinociceptive properties due to its non-competitive NMDA receptor antagonism, blocking ion channels in a voltage-dependent fashion.[5] Our study hypothesis was that the addition of magnesium to epidural bupivacaine and fentanyl could improve intraoperative anaesthesia and postoperative analgesia in women undergoing elective caesarean section using a CSE technique.

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Correspondence to: Ayman Abd Al-Maksoud Yousef, MD, Department of Anesthesia, Faculty of Medicine, Tanta University, Tanta, Egypt.
*E-mail address:* Ayman.yousef@rocketmail.com

## Methods

The study was approved by an Investigational Review Board. Informed consent was obtained from all patients participating in the study. Healthy (ASA I, II),

18–40 year old women at term were allocated into two groups using computer-generated randomisation. Both nulliparous and multiparous women were included; all were scheduled for elective caesarean section and wished to be conscious during surgery. Exclusions were patients with pre-existing pregnancy-induced hypertension requiring treatment, hepatorenal or other end organ disease, twin pregnancy, placenta praevia, opioid agonist or agonist/antagonist administration in the preceding 6 h (or within 1 h if given intravenously), obesity (BMI >38 kg/m2), extremes of height (<140 or >180 cm), active labour or those who had contraindications to neuraxial block.

The operating theatre nurse assistant used the randomisation protocol to assign participants to their respective groups, and an independent anaesthesiologist, who did not participate in the study or data collection, prepared unlabelled syringes containing the study drugs.

Patients were premedicated with oral ranitidine 150 mg the night before and on the morning of surgery. The second dose was given with oral metoclopramide 10 mg. In the operating theatre patients were monitored using electrocardiogram, pulse oximeter, and a non-invasive blood pressure device. A fluid preload of 500 mL of lactated Ringer's solution was given and baseline blood pressure and heart rate were recorded in the left wedged supine position. Oxygen at 6 L/min was administered via a face mask.

In the sitting position, CSE anaesthesia was performed using a needle-through-needle technique (Epi-Star CSE, Maxi-Set, Kemen, Germany). The epidural space was located using loss of resistance to air with an 18-gauge Tuohy needle, and dural puncture was achieved with 27-gauge pencil point needle. After confirmatory aspiration of cerebrospinal fluid, 2 mL of 0.5% hyperbaric bupivacaine was injected intrathecally. The spinal needle was withdrawn and a 20-gauge epidural catheter inserted 3–4 cm into the epidural space. The catheter was secured and the patient placed in the supine position with left uterine displacement. All then received 22 mL of study solution via the epidural catheter. This was either 10 mL 0.25% plain bupivacaine, 10 mL 0.9% sodium chloride plus fentanyl 100 μg (Bup/Fent Group) or 10 mL 0.25% plain bupivacaine, 10 mL 5% magnesium sulphate (500 mg) plus fentanyl 100 μg (Mag/Bup/Fent Group).

Hypotension, defined as 20% fall in blood pressure from pre-induction levels or a systolic blood pressure lower than 100 mmHg, was treated immediately by intravenous injection of 5 mg ephedrine. The level of sensory block was assessed at 2-min intervals for 30 min after epidural injection using pinprick. The highest level of sensory block (S max) and time taken to reach S max were recorded. Motor block of the lower extremities was assessed at 5 min intervals for 30 min using the modified Bromage score (BS): BS0, full flexion of hip, knee and ankle; BS1, impaired hip flexion; BS2, impaired hip and knee flexion; BS3, unable to flex hip, knee or ankle. Complete motor block was defined as BS3. Time intervals from intrathecal injection to readiness for surgery, skin incision to delivery and uterine incision to delivery were recorded.

Surgery was performed by one of two consultant surgeons of similar clinical experience. They were blinded to the allocation group, and assessed muscle relaxation as poor, fair, good or excellent (score of 1, 2, 3 or 4). Intraoperative and postoperative pain were assessed on a 10-cm visual analogue scale (VAS), in which 0 represented no pain and 10 represented worst possible pain. VAS was measured every 15 min intraoperatively and every 4 h postoperatively by an anaesthesiologist who was unaware of the patient allocation group. If women complained of pain (defined as VAS >4), intravenous fentanyl was given in 50 μg increments. The requirement for supplementary analgesia was noted in different groups. Adverse effects such as hypotension, nausea, vomiting and shivering were also recorded.

All neonates were evaluated by a paediatrician who was unaware of group assignment. Apgar scores at 1 and 5 min and umbilical cord pH were recorded. The need for neonatal oxygen therapy was noted. Breast feeding was prohibited for the first 24 h after caesarean delivery.

Following surgery, patients were nursed in the post anaesthesia care unit (PACU). Recovery from motor block was defined as time from injection of epidural solution to BS0. The onset of postoperative pain, defined as the time from completion of surgery to onset of VAS >4, was recorded.

### Statistical analysis

A sample size analysis using data obtained in an initial pilot study indicated that 30 patients per group were required to detect a between group difference of at least 20% in fentanyl consumption, with a power of 80%, $\alpha$ of 0.05 and allocation ratio of 1:1. Continuous data were presented as mean (±SD). Parametric data were analysed using Student's t test, non-parametric data were analysed using Mann–Whitney *U*, and categorical data were assessed with $\chi^2$ tests. A $P$ value <0.05 was considered significant.

## Results

A total of 182 women were considered for entry into the study. Of these 52 did not meet the inclusion criteria and 40 refused to participate. The remaining 90 women were randomised into two study groups. The two groups had similar characteristics with regard to age, height, weight, baseline blood pressure, heart rate, and duration of surgery (Table 1).

There were no statistically significant differences between the groups in the time needed for the block to