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Research Article

Effect of adding magnesium sulphate to bupivacaine on the clinical profile of ultrasound-guided thoracic paravertebral block in patients undergoing modified radical mastectomy

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KEYWORDS

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Abstract *Background:* Paravertebral block is an effective perioperative analgesic modality in patients undergoing breast or thoracic surgery. Several adjuvants have been reported to improve the clinical profile of local anaesthetic-induced paravertebral block. In the present study, we hypothesized that the addition of magnesium sulphate could potentiate the analgesic effects of paravertebral bupivacaine in female patients undergoing modified radical mastectomy.

Methods: Ninety female patients ASA physical status 1 and 2 patients scheduled for modified radical mastectomy were allocated into 2 groups (45 patients each). Group (B) received bupivacaine 0.25% 0.3 ml/kg in the paravertebral space while group (BM) received 100 mg magnesium sulphate + bupivacaine 0.25% 0.3 ml/kg in the paravertebral space. Both blocks were done guided by ultrasound before induction of standard general anaesthetic technique which was the same in both groups. The two groups were assessed in the first post-operative 24 h for post-operative visual analogue scale (VAS) scores, time to first analgesic request, total 24 h morphine consumption, number of attacks of PONV and any complications from paravertebral block or from the drugs used in the study.

Results: Patients in group (BM) were found to have reduced VAS scores at 30 min, 2, 4, 6, 12, 24 h intervals post-operative. The time to first analgesic request was longer in patients of group (BM) with less amount of post-operative opioid consumption and consequently less number of attacks of PONV in first post-operative 24 h. These results were significant with a *P* value < 0.001.

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Conclusion: Adding magnesium sulphate to bupivacaine in ultrasound-guided paravertebral block resulted in more efficient analgesia and opioid-sparing in female patients undergoing modified radical mastectomy.

1. Introduction

Breast cancer surgery is the most common cancer surgery in women in the United States [1]. About 40% of breast cancer surgery patients complain from significant acute postoperative pain [2], and 50% of them develop chronic postoperative pain, commonly due to inadequate analgesia [3]. Breast surgery is frequently followed by postoperative nausea and vomiting (PONV), and restricted movement from pain [4]. One of the most promising techniques in providing better postoperative analgesia for breast cancer surgery patients is the paravertebral block (PVB) [5]. It is associated with better control of postoperative pain, less opioids requirement for postoperative analgesia, decrease in postoperative nausea and vomiting (PONV), reduced postoperative pulmonary complications and better patient outcome [5]. It was also reported that paravertebral block decreases chronic postoperative pain and improves wound subcutaneous oxygenation which leads to better wound healing and less risk of infection [6,7].

Several adjuvants as fentanyl and clonidine have been reported to improve the clinical profile of paravertebral block in breast surgery but addition of these adjuvants was associated with more adverse effects as hypotension and vomiting [8]. Paravertebral clonidine was also found to have a sedative effect [9]. Hence the need to try another adjuvant with better analgesic profile and with less adverse effects.

Magnesium is a competitive NMDA (N-methyl D-aspartate) receptors antagonist. NMDA receptors are excitatory amino acid receptors which are activated by various excitatory amino acid neurotransmitters such as glutamate and aspartate in response to painful stimuli. Activation of NMDA receptors leads to calcium influx into the cells, the action which can be blocked by magnesium [10]. Calcium influx leads to a series of central sensitization such as wind-up phenomenon and long term potentiation which are important mechanisms that determine the duration and intensity of post-operative pain, hence the role of magnesium as a NMDA receptors antagonist in the prevention of these cascades of reactions leading to reduced post-operative pain [11].

The mechanism of analgesic action of magnesium when injected in paravertebral space where the spinal nerves and posterior rami pass is still unclear. Theories about how magnesium exerts its action in paravertebral space may be systemic effect, epidural spread or direct action on the peripheral nerves. Systemic effect can be excluded as the dose of magnesium used in our study was a small dose and it was likely to be too low to produce a systemic effect or to pass through blood brain barrier. Also epidural spread is uncertain due to the absence of epidural side effects of local anaesthetic as hypotension. So the mechanism is likely the direct action of magnesium on the peripheral nerve by blocking the release of excitatory neurotransmitter at the synaptic junction or by potentiating the effect of local anaesthetic [12].

Magnesium has been used as an adjuvant to local anaesthetics in thoracic surgery and was found to improve analgesic efficacy [13]. The analgesic efficacy of magnesium in local anaesthetic-induced paravertebral block was not tried before in breast surgery.

We designed this study to evaluate the effect of magnesium sulphate as an adjuvant in potentiating the analgesic effect of bupivacaine in paravertebral block in breast cancer surgeries.

2. Patients and methods

After obtaining approval from the local Ethics Committee and written informed consent, 90 female ASA physical status 1 and 2 patients scheduled for modified radical mastectomy were enrolled in this study. This study was carried out at National Cancer Institute – Cairo University. The exclusion criteria were local infection at the site of the block, coagulation disorders, body mass index > 35, allergy to local anaesthetics or magnesium sulphate, patient refusal, severe respiratory or cardiac disorders, pre-existing neurological deficits, liver or renal insufficiency, pregnancy, breast reconstruction surgery, bilateral breast surgery, kyphoscoliosis, presence of acute herpes zoster, chronic pain syndrome, chronic analgesic use and psychiatric disease.

During the pre-anaesthetic assessment visit patients were educated about reporting pain on the 11-point visual analogue scale (VAS), where 0 = no pain and 10 = worst imaginable pain, and were also educated how to use the patient-controlled analgesia pump.

On arrival to the operating room, basic monitoring was initiated using non-invasive blood pressure measurements, continuous electrocardiography and pulse oximetry. Before induction of general anaesthesia, all patients received ultrasound-guided (US) thoracic paravertebral block (TPVB). The scanning probe was linear multi-frequency 13–16 MHz probe. The patients were sedated with midazolam 2 mg i.v. to relieve anxiety and provide comfort during the block. The patients were placed in the lateral position with the side of the surgery upwards. The site of paravertebral block was sterilized using iodine solution, and the ultrasound probe was covered by a disposable sterile cover.

After location of the paravertebral space by US, a 26-gauge needle was inserted 2.5 cm lateral to the cephalic edge of the fourth thoracic vertebral spinal process and skin and subcutaneous tissue were anaesthetized with 5 ml of lidocaine 20 mg/ml. High frequency linear ultrasound (U/S) probe was used to locate the paravertebral space and a 18 G Touhy needle was inserted perpendicular to hit the transverse process by an out-of-plane approach. After hitting this bony structure, the needle was redirected cephalic at 15° towards the paravertebral space. After localization of the needle in the paravertebral space and negative aspiration, injection of the medication prepared for each group of the study was