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Research Article

Magnesium sulfate in femoral nerve block, does postoperative analgesia differ? A comparative study

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Abstract *Background:* N-methyl-D-aspartate (NMDA) receptors play a major role in central nociceptive transmission. Recent studies identified NMDA receptors peripherally. Magnesium (Mg) has antinociceptive effects due to its antagonistic effect of NMDA receptors. The aim of this randomized, double-blinded, placebo-controlled study was to assess the potential analgesic effect of Mg when directly applied on the peripheral nerves, as well as to evaluate the efficacy of Mg to facilitate the local anesthetic effect of Bupivacaine during peripheral nerve block.

Methods: Sixty patients, ASA physical status I, II & III, undergoing laser photocoagulation were randomly divided into 2 equal groups. Both groups received femoral nerve block using nerve stimulator. Patients of group A were given Bupivacaine and Magnesium sulfate, while patients of group B were given Bupivacaine and saline. Pain was assessed using Visual analogue scale (VAS). The duration of action of Bupivacaine was determined by assessing the duration of sensory block, as well as, assessing the motor block of the quadriceps muscle in both groups. 75 mg of Diclofenac sodium was administered IM as a rescue analgesic. The total dose of the Diclofenac sodium used was recorded.

Results: The current study showed a significantly shorter duration of action of Bupivacaine, with a significantly lower pain scores among patients of group A. On the other hand, bearable pain period was significantly shorter, and the total consumption of Diclofenac sodium in the 24 h postoperatively was significantly higher in group B.

Conclusion: The current study concluded that the admixture of magnesium to bupivacaine provides a profound prolongation of the femoral nerve block, in addition to a significant decrease in

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postoperative pain scores and total dose of rescue analgesia, with a longer bearable pain periods in the first postoperative day.

1. Introduction

Magnesium (Mg) is the fourth most abundant cation in the body and the second most abundant intracellular cation, it activates many of the enzyme systems involved in energy metabolism and acts as a natural calcium antagonist that regulates calcium access into the cell, in addition, Magnesium can be considered as a physiological blocker of N-methyl-D-aspartate (NMDA) receptors [1].

Magnesium (Mg) has antinociceptive effects due to its antagonistic effect of NMDA receptors [2]. N-methyl-D-aspartate (NMDA) receptors play a major role in central nociceptive transmission, modulation and sensitization of acute pain states [3]. In addition to their central location, recent studies identified NMDA receptors peripherally in the skin [4], muscles [5] and knee joints, and found that they play a role in sensory transmission of noxious signals [6]. In its inactive state, the NMDA receptor is blocked by the presence of a centrally positioned magnesium ion, the afferent activity in nociceptor fibers dislodges the central magnesium ion from the NMDA receptor, therefore allowing calcium influx into the cells [7].

The nerve stimulation is a well established method of nerve location during applying a peripheral nerve block, generally, it is accepted that the generated electrical current at the tip of the insulated needle used in the block produces a motor response before the needle enters the perineurium or even comes in direct contact with the nerve, so reducing the incidence of nerve trauma and intraneural injection [8,9]. We hypothesized that the addition of Magnesium sulfate to local anesthetics during peripheral nerve block would prolong the duration of the block.

The aim of this randomized, double-blinded, placebo-controlled study was to investigate the potential analgesic effect of Magnesium sulfate and its possible efficacy to prolong the duration of action of Bupivacaine when administered together for the femoral nerve block in patients undergoing laser photocoagulation of varicose veins of lower limbs.

2. Patients and methods

After obtaining approval from the Clinical Research Ethics Committee of Erfan and Bagedo General hospital and obtaining informed consent, Sixty patients, ASA physical status I, II & III, undergoing laser photocoagulation for varicose veins of the lower limb were included in this study. The patients were randomly divided into 2 equal groups: Group A patients (n = 30) received femoral nerve block with Bupivacaine and Mg and Group B patients (n = 30) received femoral nerve block with Bupivacaine and saline. Inclusion criteria were as follows: age >18 yr old; ability to consent; and ability to understand and communicate, Exclusion criteria were cardiovascular, hepatic or renal dysfunction, neuromuscular diseases, opioid or analgesic abuse, and prior treatment with calcium channel blockers.

All patients were premedicated with 5 mg midazolam I.M. 30 min before shifting to OR. After admission to OR, the standard monitors including noninvasive arterial blood pressure, electrocardiography and pulse oximetry were applied. A 20 gauge intravenous catheter was inserted. With the patient in supine position and an oxygen open facemask applied at 5 L/min, the inguinal region was exposed and scrubbed with povidone iodine solution. The site of the needle insertion was identified as a point 1 cm lateral to the femoral artery at the level of the inguinal crease, and this site was anesthetized with 2 ml lidocaine 2%. A 21 gauge, 50-mm insulated stimulating needle (Simplex A-B Braun Melsungen AG 34209 Melsungen Germany) was used; it was connected to the nerve stimulator (Pajunk nerve stimulator multistim sensor. Karl-Hall-Strabe 1-D-78187 Geisingen Germany), with the nerve stimulator being connected to an ECG electrode applied on the lateral side of the thigh of the patient. The nerve stimulator was set at 1.5 mA, 2 Hz, 0.1 ms, and the needle was inserted through the skin and propagated gradually in a cephalad direction at a 45° angle to the skin surface while maintaining needle orientation in a parasagittal plane till the femoral nerve was stimulated resulting in contraction of the Quadriceps Femoris which cause proximal patellar movement. The needle was positioned to optimize the muscle contraction, and then the current was decreased gradually until the best muscle contraction was obtained at a current of 0.2–0.4 mA.

In group A, patients were injected with 20 ml Bupivacaine 0.25% and 5 ml of magnesium sulfate 10% solution (500 mg) a total volume of 25 ml, through the needle directly on the femoral nerve, While in group B, patients were injected with 20 ml Bupivacaine 0.25% and 5 ml normal saline 0.9%, a total volume of 25 ml. All the patients enrolled in the study were randomly assigned using concealed envelope method to one of the two groups, in addition, patients as well as the anesthetist and the surgeon were blinded to the type of the medications injected and the master codes were kept with a person that does not share in the collection or analysis of the results.

The severity of pain was assessed using 10 mm linear Visual analogue scale (VAS), where a score of 0 was considered as pain free, while a score of 10 was considered as the worst imaginable pain. Pain was assessed at 1, 3, 6, 12, and 24 h postoperatively. Furthermore, the duration of action of Bupivacaine was determined by assessing the sensory block at the antromedial aspect of the middle third of the thigh using pinprick method compared with the same site in the contralateral thigh as a reference, as well as, assessing the motor block of the quadriceps muscle, both of which were recorded every 30 min. The duration of sensory block was considered as the time interval between the local anesthetic injection and the complete recovery of sensation, and the duration of motor block was the time interval from local anesthetic injection till the recovery of motor activity.

If the VAS pain scores recorded increases more than 5, Diclofenac sodium 75 mg was administered IM as a rescue analgesic. The total dose of the Diclofenac sodium used was recorded. Bearable pain period was measured and is defined