The effect of intravenous infusion of magnesium sulphate during spinal anesthesia on post-operative analgesia in patients undergoing total hip replacement

Thesis

For Partial Fulfilment of Master Degree in Anesthesia

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2019

*First, thanks to **Allah**, the Most Gracious, Most Merciful, for guiding me and giving me strength to complete this work.*

*I would like to express my deepest thanks to **Prof. Dr. Waleed Abd EL Mageed Eltaher**, Professor of Anesthesia, Intensive Care and Pain Management, Ain Shams University, for his close supervision, valuable instructions and continuous help, for which he generously devoted much of his time and effort. It was a great honor for me to work under his direct supervision.*

*I would like to express my deepest thanks and gratitude to **Prof. Dr. Mostafa Mansour Hussien** Lecturer of Anesthesia, Intensive Care and Pain Management, Ain Shams University, for his kind supervision, indispensable advice, sincere efforts, and help to get this work done.*

*I also wish to express my gratitude to **Dr. Sameh Ahmed Refaat** Lecturer of Anesthesia, Intensive Care and Pain Management, Ain Shams University, for his indispensable advice and great help in this work.*

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List of Abbreviations

ASA	: American Society of Anesthesiology
CNS	: Central nervous system
CO	: Cardiac output
COX	: Cyclooxygenase
CVS	: Cardiovascular system
Mg	: Magnesium
NMDA	: N-methyl-D-aspartate
NSAIDS	: Nonsteroidal anti-inflammatory agents
VAS	: Visual analog scale

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Introduction

Fundamental of regional anesthesia is pharmacologically interrupting transmission of sensation in the specific nerve fiber. The sensory signals generated by tissue damage triggers a state of increased excitability, leading to prolonged post-operative pain or sensitization to such pain. The optimal pain treatment pre-empts the establishment of pain hypersensitivity during and after surgery by minimizing the patient discomfort while leaving physiologic nociceptive mechanisms intact so as to function as an early warning symptom ***(Kahraman, 2014).***

Total hip replacement arthroplasty is accompanied by moderate to severe pain after surgery and adequate postoperative pain management is important for early rehabilitation and functional recovery ***(Kumar, 2013).***

Magnesium (Mg) is the fourth common cation in body. It has antinociceptive effects due to its antagonistic effect of N-methyl-D-aspartate (NMDA) receptor through regulation of Ca influx into cells. Numerous clinical investigations have demonstrated that Mg infusion during general anesthesia reduced anesthetic requirement and postoperative analgesic consumption, whereas other

studies suggested that perioperative Mg administration had little effect on postoperative pain ***(Shah, 2016).***

With this background, we hypothesized that concomitant use of intravenous infusion of magnesium sulfate may have an effect on the block characteristics and duration of action of intrathecal bupivacaine. This study was planned to evaluate and observe the effect of concomitant intravenous infusion of magnesium sulfate in the patients undergoing lower limb orthopedic surgery under subarachnoid block with Bupivacaine on postoperative analgesia ***(Choksi, 2018).***

Aim of the work

To measure the effect of intravenous magnesium infusion during spinal anesthesia on post operative analgesia in patients undergoing total hip replacement.

Magnesium Sulfate

Pharmacologic classification: Mineral/ Electrolyte:

Magnesium is one of the most abundant substances in the body, participating in literally hundreds of metabolic processes, from glucose metabolism to DNA synthesis. Our intake is from green leafy vegetables, whole grains and nuts ***(Robson, 2014)***.

Routes of administration

- Parenteral injection: 10%, 12.5%, 50%
- IM
- Mouth
- Topical

Indications and dosages:

1. Anticonvulsant

A. Hypomagnesemic seizures. Adults: 1 g I.V. or I.M. Or, 1 to 2 g (as 10% solution) I.V. over 15 minutes; then 1

g I.M. q 4 to 6 hours, based on patient's response and magnesium blood levels .

B. Seizures secondary to hypomagnesemia in acute nephritis.. Adjust dosage according to magnesium blood levels and seizure response .

C. Prevention or control of seizures in preeclampsia or eclampsia. Magnesium sulfate is the primary treatment and preventative measure in women with eclampsia. It lowers systolic blood pressure while maintaining diastolic blood pressure, thus leaving blood flow to the fetus uncompromised.

Doses

Initially, 4 g I.V. in 250 ml D5W and 4 to 5 g deep I.M. into each buttock (using undiluted 50% magnesium sulfate injection); then 4 to 5 g deep I.M. into alternate buttock q 4 hours, p.r.n. Or, 4 g I.V. as a loading dose followed by 1 to 3 g hourly as an I.V. infusion. Maximum daily dose is 30 to 40 g. Or, 8 to 15 g depending on weight of patient

4 g of magnesium sulfate (as magnesium sulfate injection or magnesium sulfate in D5W) is given I.V. and the remaining dose is given I.M. using undiluted 50% magnesium sulfate injection. Dosage over next 24 hours

based on serum level and urinary excretion of magnesium following initial dose. Later doses should be sufficient to replace magnesium excreted in urine, about 65% of the initial dose given I.M. q 6 hours ***(Herroeder et al., 2011).***

2. Tocolytic:

Management of preterm labor. Adults: 4 to 6 g I.V. over 20 minutes as a loading dose, followed by maintenance infusions of 2 to 4 g/hour for 12 to 24 hours as tolerated after contractions subside .

3. Antiarrhythmic

Intravenous magnesium therapy has been used for the treatment of ventricular arrhythmias. The intravenous administration of magnesium sulfate (100 mg/kg) reduced the incidence of the ventricular arrhythmias of all models

Magnesium sulfate possesses multiple electrophysiological properties and that the effects related to the calcium channel inhibition may be the most relevant for the antiarrhythmic actions ***(Sugiyama et al., 2016)***

Doses:

For patient with sustained ventricular tachycardia or torsades de pointes, give 1 to 6 g I.V. over several minutes followed by 3- to 20-mg/minute I.V. infusion for 5 to 48

hours depending on patient response and serum magnesium levels. For patient with paroxysmal atrial tachycardia, give 3 to 4 g I.V. over 30 seconds.

Reduction of cardiovascular morbidity and mortality caused by acute MI. Adults: 2 g I.V. over 5 to 15 minutes, followed by infusion of 18 g over 24 hours (12.5 mg/minute). Start therapy as soon as possible, and no longer than 6 hours ***(Trinka et al., 2016).***

4. Broncodilator

In an asthma attack, the airways are narrow from muscle spasm and swelling (inflammation). Bronchodilator drugs (reliever inhalers) can be used to relax the muscles and open the airways, and corticosteroid drugs to reduce the inflammation. Magnesium sulfate is a drug that can also affect muscles, and may inflammation as well.

Doses

A single dose of 1.2 g or 2 g over 15 to 30 minutes

5. Others

- Constipation
- Barrium poisoning

Dosage adjustment

- For patients with severe renal insufficiency, maximum dose is 20 g in 48 hours .
- Barium poisoning, asthma. Adults: 1 to 2 g I.V.

Pharmacodynamics:

Magnesium is a calcium antagonist at the motor endplate of nerves in many types of muscle, including cardiac muscle. Calcium is thus integral to smooth muscle contraction and calcium inhibition results in muscle relaxation, Increased magnesium levels appear to disrupt the balance between calcium and magnesium ions, altering muscle action. As well as its peripheral effects, magnesium sulphate blocks N-methyl-D-aspartic acid (NDMA) receptors in the central nervous system and this appears not only to reduce involuntary muscle action, but also to reduce nerve excitability and possibly seizure activity by blocking neuromuscular transmission and its associated ion channels N-methyl-D-aspartate receptor antagonists can prevent the induction of central sensitization due to peripheral nociceptive stimulation and abolish the hypersensitivity once it is established ***(Sina et al., 2016).***

Pharmacokinetic:

Absorption:

The oral absorption of magnesium sulphate is notoriously unpredictable, so parenteral routes – either intravenous or intramuscular – are the only reliable methods of administration. Standard solutions contain 50 per cent magnesium sulphate as a heptahydrate in sterile water, with five grams of magnesium in 10ml of the solution. The absorption is rapid, with peak serum levels achieved within one hour of intramuscular injection, and almost immediately following intravenous use. Owing to its pharmacology, it must be used with extreme caution in patients with heart block and myasthenia gravis ***(Trinka et al., 2016).***

Distribution:

Distributed widely throughout the body.

Metabolism:

None.

Excretion:

Excreted unchanged in urine, in patients with normal renal function, all magnesium sulfate is excreted within 24 hours of discontinuing drug some appears in breast milk ***(Trinka et al., 2016).***