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INTRAVENOUS MAGNESIUM SULPHATE FOR POSTOPERATIVE ANALGESIA IN LOWER LIMB ORTHOPAEDIC SURGERIES UNDER SPINAL ANESTHESIA: A RANDOMIZED, DOUBLE-BLIND TRIAL

Anaesthesiology

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ABSTRACT

Background*:* Spinal anesthesia is an preffered mode of anesthesia for lower limb orthopedic surgeries. The limitations of the spinal anaesthesia are short duration of action and limited post-operative analgesia. This study is aimed to evaluate the efficacy of the intravenous magnesium sulphate infusion for post operative analgesia in lower limb orthopaedic surgeries under spinal anesthesia.

Methods: Sixty patients were randomized into two groups. Group M received IV magnesium Sulphate 50 mg/kg in 100 mL of normal saline over 15 minutes immediately before spinal anesthesia, and then 15 mg/kg/hr until the end of the operation. Group C received 100 ml of normal saline over 15 min followed by infusion at the rate of 100 ml/hr till the end of surgery. The primary outcomes measured were the pain intensity assessed at rest and on movement at 4 , 24 hours after the operation, using the VAS score and tramadol consumption in first 24 hour. Secondary outcomes measured were mean arterial blood pressure and heart rate at time 0 (before the study drug), 15, 30, 60, 90, and 120 minutes during the surgery, one hour after admission in the PACU and side effect if any present.

Results: Postoperative VAS scores were lower in Group M at rest and on movement at 4 hours and at 24 hours. There was significant difference between Group M and Group C concerning the tramadol consumption (P = 0.001). Hemodynamic parameters were similar in both groups and statistically not significant. The incidence of hypotension, nausea vomiting were similar in both groups.

Conclusion: Use of intravenous magnesium sulphate infusion with spinal anesthesia reduces post-operative pain and analgesic consumption.

KEYWORDS

Magnesium sulphate , postoperative analgesia, spinal anaesthesia

INTRODUCTION

Adequate postoperative analgesia allows early mobilization with fewer complications and it is essential for improved postoperative recovery[1,2]. 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.[3,4] Perioperative regional anesthesia is often used to provide post operative analgesia. Spinal anesthesia with intrathecally adjuvants like opioids are commonly used for postoperative pain management, but they can have adverse effects like nausea, vomiting, and postoperative itching.[5] To minimize these adverse effects and optimize analgesia. intravenous (IV) magnesium sulphate is used as an adjuvant due to its analgesic properties.

The exact mechanism is not fully understood, the analgesic properties of magnesium are based on acting as a non-competitive antagonist of N-Methyl-D-Aspartate (NMDA) receptors in central nervous system and regulating the calcium influx into the cell. These properties avoid the central sensitization mechanisms due to the stimulation of peripheral nociceptive nerves.[6] Numerous clinical investigations have demonstrated that Magnesium infusion during general anesthesia reduced anesthetic requirement and may be an efficacious alternative for the postoperative analgesia.[7,8] Therefore, we conducted this study to evaluate the efficacy of the intravenous magnesium sulphate for post operative analgesia in lower limb orthopaedic surgeries under spinal anesthesia.

METHODS

After taking local ethical committee approval and patient informed consent, this randomized prospective study was conducted in a tertiary care centre in the month of November 2021. Sixty patients undergoing lower limb orthopedic surgeries under spinal anaesthesia with age group 18-60 years, ASA I and II were included in this study. Patient's refusal for spinal anesthesia, ASA III and IV, age > 60 years, known allergy to study drug Hypertensive patients, patients with cardiac disease, diabetes mellitus, body mass index (BMI) ≥ 40 kg m−2, renal, and hepatic dysfunction, neuromuscular diseases, using calcium channel blockers, and inappropriate for spinal anesthesia were excluded from this study.

60 patients were divided into 2 groups (30 each). Group M received IV Magnesium Sulphate ($MgSO_4$) 50 mg/kg in 100 mL of normal saline over 15 minutes immediately before spinal anesthesia, and then 15 mg/kg/hr until the end of the operation, Group C (control) received 100 ml of normal saline over 15 min followed by infusion at the rate of 100 ml/hr till the end of surgery On arrival to operating room, patients were monitored using electrocardiogram, non-invasive arterial blood pressure, and pulse rate and SpO_2. Intravenous cannula of 18 gauge was inserted in one arm and was preloaded with 500 ml ringer lactate at 10ml/kg/hr. Patients were given antiemetic prophylaxis metoclo pramide (10 mg IV). Under strict aseptic precaution spinal anaesthesia was performed in the sitting position. The spinal anaesthesia was given at L2-3 or L3-4 interspace. Intrathecal injection of bupivacaine heavy 0.5% in a volume of 3 ml was given intrathecally. Immediately after the blockade, patients was placed in supine position. and i.v infusion of the study drug was started as per group allotted. Supplemental oxygen (4 L/min) by a clear face mask was started.

The loss of pinprick sensation evaluated the level of sensory block. Surgery was started after achieving a sensory block of T10 or above and Bromage score of 3. Mean Arterial Blood Pressure (MAP) and Heart Rates (HR) at time 0 (before the study drug infusion), 15, 30, 60, 90, and 120 minutes during the surgery, and one hour after admission in the PACU were recorded.

Hypotension was defined as a decrease in systolic arterial blood pressure by 20% from baseline values, and was treated with fast i.v infusion of Ringer Lactate solution and inj mephentermine-6 mg i.v bolus. Bradycardia was defined as heart rate decreases to less than 50 bpm, and it was treated with inj atropine 0.5 mg IV. At the end of the surgery, respective infusions were stopped, and patients shifted to post anesthesia care unit. Pain assessments were performed utilizing visual analogue scale (VAS). Pain intensity were assessed at rest and on movement (from lying to sitting on the bed) at 4 and 24 hours after the operation. VAS ≥4 was treated with injection tramadol 100 mg IV. Further boluses of tramadol 100 mg were administered as per need of the patient. Total consumption of inj tramadol over the first 24 h post-operative period was noted.

Parametric data was expressed as mean±SD, All statistical analyses was carried out using SPSS 15. Statistical analysis was carried out using student's t-test for parametric data and chi square test, fischer's exact test for non parametric data with p value <0.05 was taken to be statistically significant.

RESULTS

A total of sixty patients were randomly divided into 2 groups (30 each). There was no significant difference in the studied groups according to demographic data, ASA status and duration of surgery (Table 1).

Hemodynamic parameters such as heart rate and mean blood pressure at baseline , 15, 30, 60, 90,120 minutes after surgery and at post anaesthesic care unit were similar in both groups and statistically not significant (Table2, Table 3)

Postoperative VAS scores were lower in Group M at rest and on movement than in Group C at 4 hours and at 24 hours. There was significant difference between Group M and Group C concerning the 24 hour tramadol consumption (180 ± 25.38 mg versus 255 ± 38.30 mg, P = 0.001). (Table 4)

Incidences of intraoperative complications are depicted in (Table 5). Hypotension in both groups responded to i.v administration of injection Mephentermine 6 mg bolus. Injection Onensetron 4 mg IV is used in case of nausea vomiting

Table 1: Comparison Between Studied Groups As Regards To Demographic Data, Asa Status And Duration Of Surgery

PARAMETERS	GROUP M (n=30)	GROUP C (n=30)	P value
	Mean ±SD	Mean ±SD	
AGE (yr)	42.5 ±5.7	43.9±6.7	0.387
WEIGHT	72.1±6.3	74.4±6.2	0.159
HEIGHT (cm)	160.3±5.2	161.0±6.7	0.652
ASA I/II	16/14	18/12	
DURATION OF SURGERY	104.4±20.2	102.2±17.0	0.647

Table 2: Comparison Between Studied Groups As Regards With Heart Rate

HEART RATE	GROUP M	GROUP C	P value
Baseline	91.93±11.2	91.2±14.9	0.830
After 15 mins	88.03±10.7	88.6±13.7	0.858
After 30 mins	86.53±10.95	87.0±13.5	0.882
After 60 mins	85.66±10.74	87.83±12.23	0.468
After 90 mins	86.83±11.02	88.13±11.1	0.650
After 120 mins	87.9±10.1	89.14±9.5	0.626
At PACU	89.20±9.2	90.4±6.7	0.565

Table 3: Comparison Between Studied Groups As Regards To Mean Blood Pressure

MEAN BLOOD PRESSURE	GROUP M	GROUP C	P value
Baseline	94.9±8.93	97.73±9.8	0.247
After 15 mins	88.73±6.76	89.7±8.4	0.624
After 30 mins	86.83±8.6	85.33±8.41	0.497
After 60 mins	84.16±7.3	86.23±7.53	0.860
After 90 mins	83.9±7.13	87.33±7.79	0.721
After 120 mins	85.6±6.9	88.1±8.2	0.206
At PACU	89.7±9.0	94.2±7.8	0.112

Table 4: Comparison Between Studied Groups As Regards Vas Score And Tramadol Consumption

	GROUP M	GROUP C
VAS at rest 4h after surgery	1 (0-4)	3(3-5)
VAS on movement 4h after surgery	4(2-5)	5(5-8)
VAS at rest 24h after surgery	1.4(0-2)	2.2(1-4)
VAS on movement 24h after surgery	3(2-5)	4.4(3-6)
Tramadol consumption (mg)	180±25.38	255±38.30

Table 5:intraoperative Complications

Intraoperative complications	GROUP M	GROUP C
BRADYCARDIA	0	0
HYPOTENSION	1	2
NAUSEA VOMITING	1	3
PURITIS	0	0

DISCUSSION

The aim of this study was to evaluate the efficacy of the intravenous magnesium sulphate for post operative analgesia in lower limb orthopaedic surgeries under spinal anesthesia. Sixty patient were enrolled in this study. The results of this study showed that that intravenous magnesium sulphate infusion during lower limb orthopaedic surgery under spinal anesthesia reduced postoperative pain scores . We also observed that tramadol requirement is less with magnesium sulphate, without significant hemodynamic variability or adverse effects.

Use of magnesium sulphate is associated with beneficial effects in perioperative period and postoperatively.[9,10] Magnesium has been found to have multisystemic effects in the body involving the cardiovascular,[11,12] central nervous systems, analgesia,[13,14] decrease in catecholamine surges, management of asthma, eclampsia, tetanus and in intensive care .Although the exact mechanism is not fully understood, the analgesic properties of magnesium are based on acting as a non competitive antagonist of NMDA receptors in the central nervous system and in the peripheral tissues.[15] It also acts by regulating the influx of calcium into the cell.

A systematic review carried out in 2013 by **Albrecht et al**.[16] that included two studies in which patients received spinal anesthesia and general anesthesia, concluded that perioperative IV magnesium reduces opioid consumption and also reduces pain scores in the first 24 postoperative hours. Recently, several studies have reported the benefits of IV magnesium infusion in the postoperative pain scores and opioid consumption of patients who undergone surgery under general anesthesia.[17-22]. In some studies, the patients received only bupivacaine and in other studies, the patients received only bupivacaine or bupivacaine +10-20 g fentanyl[23,24] showed a consistent decrease in opioid consumption, and decrease in pain scores up to 48 hours postoperatively. In our study, pain scores was lower at 4 hour and at 24 hour after surgery

In our study 24 hour tramadol consumption were less in magnesium sulphate group, our result were similar to the study conducted by **Agrawal et al**.[23] in patients undergoing lower limb orthopedic surgeries, the consumption of tramadol in the group that received magnesium compared to the group that received saline was (190 ± 30 mg vs. 265 ± 48 mg; p = 0.000).

In our study we found that the mean blood pressure and heart rate were similiar among the two groups at baseline , 15, 30, 60, 90, 120 minutes after surgery and at post anaesthesic care unit and the difference was statically non significant. These results are similar to studies conducted by **Hwang et al**[25] and **Agrawal et al**[23] According to these studies, the pre-hydration with 500 mL of Ringer's lactate and the slow infusion of the medication explains this hemodynamic stability.

In our study Side-effects reported were minor and included hypotension (3.33%), nausea vomiting(3.33%), which was treated by i.v administration of injection mephentermine 6 mg bolus and Injection Onensetron 4 mg IV respectively. This is slightly less than previously studies.[25]

CONCLUSION

The study result showed that the use of intravenous magnesium sulphate infusion with spinal anaesthesia reduces the post-operative pain and analgesic requirement in lower limb orthopedic surgeries without significant hemodynamic variability or adverse effects .

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