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Assessment of value of epidural magnesium sulfate in postoperative analgesia after lower limb vascular surgery

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Abstract

Objective

The aim of the study was to assess the value of epidural magnesium sulfate in postoperative analgesia after lower limb vascular surgery.

Patients and methods

A total of 80 patients planned for elective lower limb vascular surgery were enrolled in a double-blind comparative study. Their ages were between 30 and 60 years and were of ASA physical status I–III. Patients were randomly distributed into two groups: group A ($n = 40$) included patients who received 100-mg magnesium sulfate in 6 ml normal saline 0.9% plus 4 mg morphine epidurally, and group B ($n = 40$) had patients who received 4 mg morphine in 6 ml normal saline 0.9% epidurally.

Results

Regarding demographic data, no statistically significant difference was observed between the two groups. No significant difference in pain on visual analogue scale scores at 0 min to 2 h was found between both the groups, but there was a statistically significant lowering in pain on visual analogue scale between both the groups at 2 and 24 h at both rest and on movement. No significant difference between both the groups was found regarding the duration of the motor block. Regarding time to the first request of analgesia, there was a statistically considerable prolongation in group A. Regarding vital signs, there were no statistically significant differences observed between the two groups.

Conclusion

In the present clinical study, magnesium, which was administered epidurally, appeared to prolong the duration of morphine analgesia without noteworthy adverse effect. Furthermore, epidurally administered magnesium has an excellent safety profile in humans.

Keywords: Analgesia, epidural, motor block

INTRODUCTION

Patients with peripheral vascular surgery have been classified as high-risk group, where cardiac death and nonfatal myocardial infarction in up to 5% of the cases can occur. Postoperative pain and anxiety as stress responses should be carefully controlled, and myocardial ischemia is of most critical worry postoperatively [1].

Regional anesthesia is a safe, affordable technique, with the benefit of prolonged pain alleviation postoperatively [2]. Poly-pharmacology treatment has turned out to be a fundamental practice for postoperative pain because no medication has yet been distinguished that mainly inhibits nociception without related adverse effect [3]. Combined

spinal epidural block has the advantage of rapidity, density, and reliability of the subarachnoid block, advocated with the adaptability of the continuous epidural block to expand the span of absence of pain. The CSE procedure is utilized widely in major vascular surgery [4].

However, in vascular surgery population, anticoagulant and antiplatelet therapy is common and regularly blocks the utilization of spinal or epidural technique; the anesthesiologist must think about the agent used the span of discontinuance,

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current coagulation status, and concomitant administration of medications that affected hemostasis [5]. Opioids have both presynaptic and postsynaptic effects in the dorsal horn and change the balance of nociceptive input but do not cause motor or sympathetic blockade.

Opioid-based techniques are used widely. These techniques are usually based on administration of drugs like morphine and pethidine as a bolus or the administration of an opioid such as fentanyl by continuous infusion [6]. Epidural morphine displayed an activity of moderate beginning, broad and delayed rostral spread bringing about postpone respiratory dependency and broadband of the absence of pain encompassing the site of infusion, and a relatively long span [7].

Magnesium has anticipative effect in pain models in human and animals. The effects are basically in light of the control of calcium influx into the cell. Magnesium is a natural physiological calcium antagonist and antagonist of *N*-methyl-d-aspartate receptor. Intrathecal magnesium has been reported to enhance opioid antinociception in an acute incisional model, and it was proved that the duration of spinal opioid analgesia in humans was prolonged [8]. Administration of epidural analgesia combined with magnesium postoperatively has provided consumption without any adverse effect [9].

Our study assessed the value of epidural magnesium sulfate in postoperative analgesia after lower limb vascular surgery.

PATIENTS AND METHODS

Between November 2015 and July 2017, 80 patients between the ages of 30 and 60 years with ASA I–III planned for elective lower limb vascular surgery, amputation, and debridement were enrolled in a double-blind comparative study, after obtaining the approval and written informed consent from the patients of the study. The exclusion criteria were heart failure, coagulopathy, raised intracranial tension, allergy to local anesthesia or opioids, and skin infection at the injection site.

Preoperatively the following routine investigation was done in all patients: echocardiography, complete blood count, coagulation profile, and liver and renal function tests. Intravenous access was established, and an infusion of Ringer's lactate solution started as a bolus dose of 500 ml in 15 min, and then at a rate of 10 ml/kg/h. Monitors were connected, including a pulse oximeter, noninvasive blood pressure, and echocardiography.

All patients had combined spinal-epidural anesthesia; patients were put in lateral or sitting position, and under strict aseptic precautions, the back was painted and draped. The tip of the lumbar spine was palpated, and L2–L3 or L3–L4 space was selected. The skin was infiltrated with ~2 ml of 1% lidocaine. The epidural space was identified by midline approach using 18-G Tuohy needle using a loss-of-resistance technique for air; an epidural catheter was then inserted into the epidural space, and the catheter was advanced into epidural 3–4 cm

beyond the previously noted distance between the skin and the epidural space.

Patients were randomized to one of two groups: group A ($n = 40$) patients received 100 mg of magnesium sulfate in 6 ml of 0.9% normal saline plus 4 mg morphine in epidural catheter, and group B ($n = 40$) patients received 4 mg morphine in 6 ml of 0.9% normal saline. Dural puncture at a lower level was performed by a 25-G spinal needle, with hyperbaric 0.5% bupivacaine, 12.5–15 mg, injected into the intrathecal space.

Sensory block was assessed bilaterally by cold discrimination using a frozen sachet of normal saline or ice club. A modified Bromage scale [5] was used to evaluate motor block (0, no motor block; 1, inability to raise the extended leg; 2, failure to flex knee; and 3, failure to flex ankle joint). During operation, the sensory block was bilaterally maintained, and epidural bupivacaine 0.5% was given with volume of 1–1.5 ml per segment, to maintain a level above T10.

After surgery completion, all patients were transferred to the general ward to be carefully nursed and observed. As the sensory blockade regressed to L1 (assessed by discrimination using a frozen sachet of normal saline or ice club), patients were randomized by closed envelop technique as one group; it was received an initial bolus of epidural analgesia.

Patients were monitored for pain scores using visual analogue scale (VAS), at both rest and on movement, at 0, 30 min, 1, 2, 6, 12, and 24 h (the VAS is a horizontal line, 100 mm in length, anchored by word descriptors at each end. The VAS score is calculated by measuring in millimeter from left-hand end to the patient's marks. The point marked by the patient represents the current state). Time to the first requirement of the analgesic supplement from the time of initial bolus was assessed using VAS, VAS4. Total morphine requirement in the first 24 h postoperatively was evaluated using VAS. Each administration (1 mg morphine) was initiated when VAS4. Modified Bromage scale was done to assess the duration of motor blocked at 30 min, hourly up to 6 and 2 h up to 12 at 24 h. Arterial pressure, heart rate, respiratory rate, and oxygen saturation were assessed at 5, 10 min, 1, 2, 3, 4, 5, 6, 8, 12, 16, 20, and 24 h. Patients were questioned about the quality of analgesia to assess their satisfaction at the end of the procedure using a four-point scale (1 = perfect, 2 = good, 3 = average, and 4 = poor) [9].

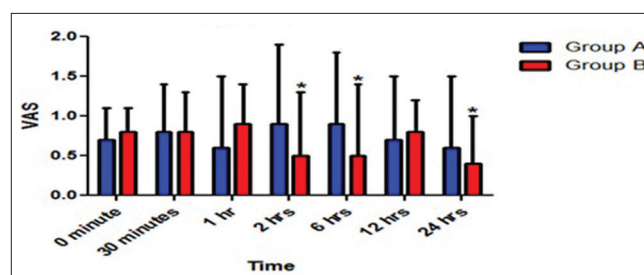


Figure 1: Visual analogue scale (VAS) at rest.

RESULTS

A randomized comparative study of 80 patients randomly divided into two groups, with 40 patients in group A (morphine + 100 mg magnesium) and 40 patients in group B (epidural morphine), was undertaken to examine the efficacy of the drugs regarding the duration of analgesia and stability pattern of hemodynamics.

VAS results at rest and movement and time to first analgesic requirement after an initial bolus of epidural analgesia were compared using Kruskal–Wallis test, with Mann–Whitney *U*-test for *post hoc* analysis. Hemodynamics variables were compared using repeated measure analysis of variants with *post hoc* Tukey test. *P* value of less than 0.05 was assumed to be statistically significant. The statistical software, namely, SPSS 15.0, IBM, International Business Machines Corp (New Orchard Road, Armonk, New York), Stata 8.0 (StataCorp LLC, 4905 Lakeway Drive, College Station, Texas 77845-4512 USA), were used for data analysis. Microsoft Word and Microsoft Excel have been used to generate graphs and tables from data.

Table 1: Demographic data and surgical characteristics

	Group A (n=40)	Group B (n=40)	P
Age	43.92±4.23	44.5±4.44	0.583
Weight	65±3.24	65±3.45	0.231
Sex (male/female) (%)	72/28	71/29	1

Data are shown as mean±SD

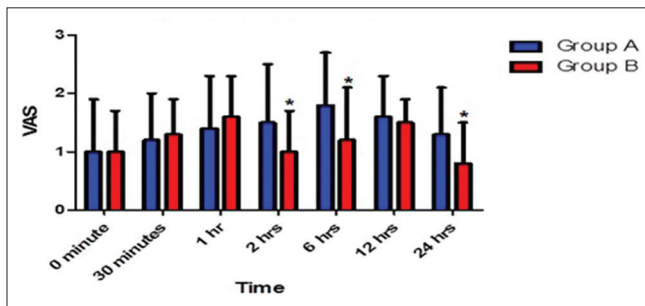


Figure 2: Visual analogue scale (VAS) on movement.

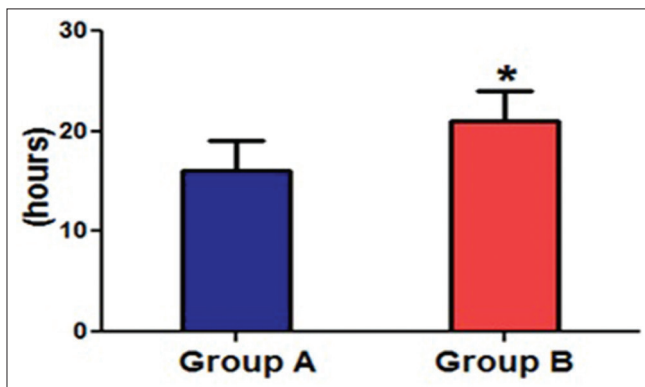


Figure 4: Time to first request of analgesia after the initial bolus.

Regarding demographic data as shown in Table 1, there was no statistically significant difference observed between both the groups.

Regarding VAS, at both rest and on movement (Figs. 1 and 2), there was no significant difference at 0 min to 2 h between the two groups, but there was a statistically significant lowering in VAS score in group A than group B at 2–24 h. The two groups showed no statistically significant differences regarding the duration of motor block (Fig. 3).

However, regarding the time to first request of analgesia after an initial bolus (h), there was a statistically significant prolongation in group A (Fig. 4).

The thesis was also supported by apparently less total morphine requirements in the first 24 h in group A (Fig. 5). There were no statistically significant differences in patient satisfaction between both the groups (Fig. 5).

Regarding vital signs, as shown in Fig. 6a–f, there were no statistically significant differences reported between the two groups.

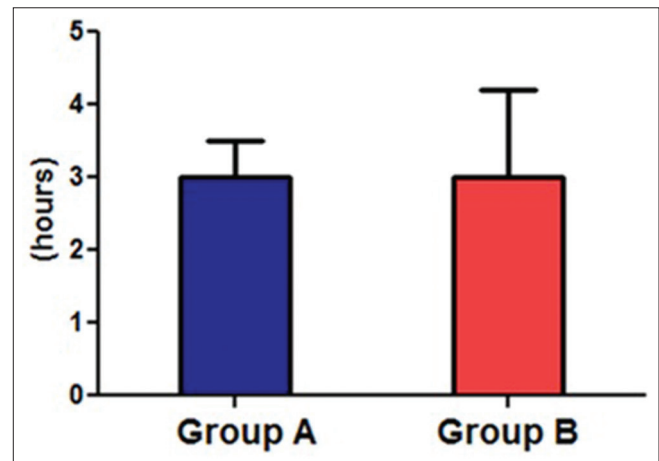


Figure 3: Duration motor block.

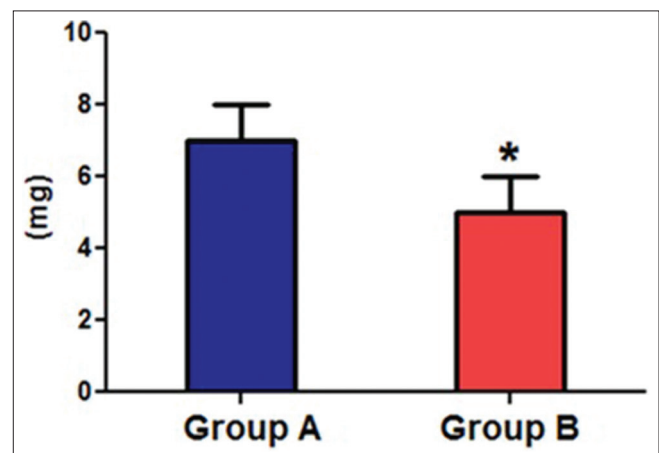


Figure 5: Total morphine requirements.

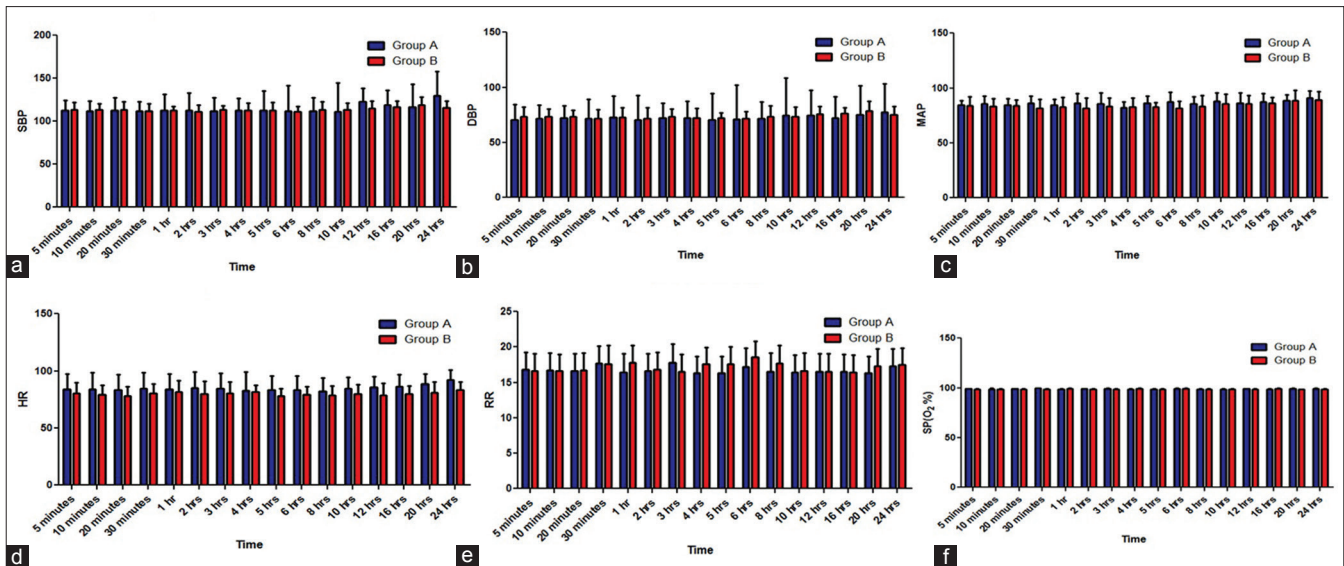


Figure 6: (a): Systolic blood pressure (SBP). (b): Diastolic blood pressure (DBP). (c): Mean blood pressure (MAP). (d): Heart rate (HR). (e): Respiratory rate (RR). (f): Oxygen saturation (SPO₂).

DISCUSSION

In the present study, the two groups were compared concerning age ($P = 0.583$), weight ($P = 0.231$), and sex ($P = 1$), and there was no significant difference observed between both the groups.

According to pain scores, in our study, there was no statistically significant difference in pain score (VAS) at both rest and on movement at 0–2 h between the two groups ($P > 0.05$). However, there was a significant lowering of pain scores (VAS) at both rest and on movement, in group A than group B at 2–24 h ($P < 0.05$). In another study [10], pain score (VAS) at both rest and movement in the first 24 h was lower in group bupivacaine + morphine + magnesium compared with other three groups, that is, bupivacaine + morphine, bupivacaine + magnesium, and B, but this significant lowering of pain score was present from the starting 0–6 h, unlike the present study, with P value of less than 0.001.

In the present study, regarding the time to first analgesia requirement, there was a statistically significant prolongation in group A (21 ± 3 h) compared with group B (16 ± 16) ($P = 0.02$). Mean total morphine requirements assessed for postoperative 24 h were lower in group A (5 ± 1 mg) than in group B (7 ± 1 mg) ($P < 0.05$). Group A had 28.5% reduced mean morphine requirement.

The present study agreed with another study [10] where the mean morphine requirement was reduced by 38%, which was higher than the current research. In the present study, there was no statistically significant difference reported between the two groups regarding the effect of morphine and magnesium on the duration of motor block ($P > 0.06$). In the present study [11,12]. In the present study, hemodynamic variables including systolic blood pressure, diastolic

blood pressure, mean blood pressure, heart rate, oxygen saturation and respiratory rates were stable, and there was no statistically significant difference between the two study groups.

The present study was similar to other studies [10,12] regarding there was no significant difference found in cardiorespiratory variables like systolic blood pressure, diastolic blood pressure, mean blood pressure, heart rate, respiratory rate or oxygen saturation, with P value more than 0.05. In the present study, there was no statistically significant difference between the two groups regarding patient satisfaction: group B, perfect = 62.5%, and group A, perfect = 77.5%, with P value more than 0.05. The present study result was unlike another study [10]. The addition of magnesium allows achievement of a comparable analgesic effect ~2–3-fold opioid dose reduction [13].

CONCLUSION

The present study has specific limitations. The study group was relatively small. Perioperative serum magnesium levels were not assessed in the study patients, which may affect the pharmacodynamics of Mg as postoperative analgesia was the primary study parameter evaluated and since the distribution of the type of lower limb, surgeries were uniform in both the groups, the possibility of bias is minimized.

Thus in the present study, magnesium is shown to prolong the duration of morphine analgesia and has an excellent safety profile administered epidurally in human.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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