

A RANDOMIZED CONTROL STUDY TO EVALUATE EFFICACY OF MAGNESIUM SULPHATE AS AN ADDITIVE TO ROPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

Supriya Aggarwal¹, Naveen Kumar Singh², Prateek Agrawal³, Vidushi Sharma¹

¹Associate Professor, Department of Anaesthesiology, KD Medical College, Hospital and Research Mathura.

²Assistant Professor, Department of Anaesthesiology, KD Medical College, Hospital and Research Mathura.

³Assistant Professor, Department of Orthopaedics, KD Medical College, Hospital and Research Mathura.

Corresponding Author:

Dr. Naveen Kumar Singh, MD, Assistant Professor, Department of Anaesthesiology, KD Medical College, Hospital and Research Mathura.

ABSTRACT

INTRODUCTION

Ropivacaine is an aminoamide local anaesthetic that is less cardiac and central nervous system (CNS) toxic than other long acting local anaesthetics like bupivacaine. Local anaesthetics alone for supraclavicular brachial plexus block provide good operative conditions but have shorter duration of postoperative analgesia.

MATERIAL AND METHODS

This prospective study was conducted in the Department of Anaesthesia at KD Medical College, Hospital and Research from November 2021 to April 2022. After obtaining permission from institutional ethics committee, written informed consent was taken from the participants. Eighty adult patients were randomly allocated to two equal groups ($n = 40$ in each group) using computer-generated random number list. Patients with the American Society of Anaesthesiologists (ASA) physical status I and II, aged between 25 and 55 years of both sexes undergoing elective orthopaedic surgeries of elbow, forearm, and hand under supraclavicular brachial plexus block were enrolled in the study. The onset and duration of sensory and motor block, the perioperative vitals and requirement of post operative rescue analgesic were compared by us.

RESULTS

In group A 50% of patients achieved grade IV quality of block in comparison to 45% in group B which was not significant ($p>0.05$). 31 patients required rescue analgesic (intramuscular diclofenac sodium injection) in group A compared to 27 patients in group B.

Conclusion

We conclude that addition of 150 mg magnesium sulphate to ropivacaine 0.50% solution in supraclavicular brachial plexus block prolongs the duration of sensory and motor blockade and reduces the requirement of rescue analgesic in postoperative period with no significant adverse effects.

Keywords: Magnesium sulphate, Ropivacaine, Supraclavicular brachial plexus block

INTRODUCTION

Peripheral nerve blocks have gained importance in modern anaesthesia practice as they offer benefits of earlier mobilisation, fewer cardiac and pulmonary complications, reduced risk of deep vein thrombosis, reduced cost of care and greater patient satisfaction[1]. Supraclavicular brachial plexus block is a popular peripheral nerve block widely employed in surgeries involving upper limb[1].

Ropivacaine is an aminoamide local anaesthetic that is less cardiac and central nervous system (CNS) toxic than other long acting local anaesthetics like bupivacaine.[2] Local anaesthetics alone for supraclavicular brachial plexus block provide good operative conditions but have shorter duration of postoperative analgesia. Hence, various adjuvants like opioids,[3] clonidine,[4] neostigmine, dexamethasone,[5] midazolam,[6] etc., were added to local anaesthetics in brachial plexus block to achieve quick, dense, and prolonged block, but the results are either inconclusive or associated with side effects.

Magnesium is second most abundant intracellular cation in body after potassium. It is necessary for presynaptic release of acetylcholine from nerve endings. Anti-nociceptive effects of magnesium are due to regulation of calcium influx into the cell and antagonism of the N-methyl D-aspartate (NMDA) receptors.[7] Magnesium has long been used for its analgesic, antihypertensive, and anaesthetic sparing effects.[8] Magnesium, after administration through epidural route, decreased postoperative opioid consumption.[9] Though magnesium has an analgesic property, it has not been studied well as an adjuvant to the local anaesthetic agents during supraclavicular brachial plexus block.

The present study was thus conducted to study the effect of adding magnesium as an adjuvant to ropivacaine in supraclavicular block.

MATERIAL AND METHODS

This prospective study was conducted in the Department of Anaesthesia at KD Medical College, Hospital and Research from November 2021 to April 2022.

After obtaining permission from institutional ethics committee, written informed consent was taken from the participants. Eighty adult patients were randomly allocated to two equal groups ($n = 40$ in each group) using computer-generated random number list.

Patients with the American Society of Anaesthesiologists (ASA) physical status I and II, aged between 25 and 55 years of both sexes undergoing elective orthopaedic surgeries of elbow, forearm, and hand under supraclavicular brachial plexus block were enrolled in the study. Patients having any known hypersensitivity or contraindication to ropivacaine or magnesium sulphate were excluded from the study. Pregnancy, lactating mothers, hepatic, renal or cardiopulmonary abnormality, alcoholism, diabetes, long-term analgesic therapy, bleeding diathesis, local skin site infections, neuromuscular disorders were considered as exclusion criteria.

Patients were randomised into 2 groups A and B. Patients in group A received 30 ml of 0.5% ropivacaine + 1 ml normal saline and patients in group B received 30 ml 0.5% ropivacaine + 150 mg (in 1 ml 0.9% saline) magnesium sulphate for supraclavicular block. Magnesium and Ropivacaine dose was chosen as per recommendation in the text book as well as experience of our previous researchers. [10,11,12,13]

All patients were clinically examined in the preoperative period, when whole procedure was explained. Visual analog scale (VAS) (0, no pain and 10, worst pain imaginable) was also explained during preoperative visit. All patients were investigated for haemoglobin level, total leukocyte count, differential leukocyte count, erythrocyte sedimentation rate, platelet count, blood sugar, blood urea, serum creatinine, and liver function tests. A 12-lead electrocardiogram (ECG) and chest X-ray were also taken. In the operative room, standard intraoperative monitors like ECG, pulse oximeter, and noninvasive blood pressure were attached and baseline parameters were recorded. Intravenous (IV) infusion of Ringers' lactate was started and oxygen was given at 3 L/min via face mask. All patients received midazolam 0.04 mg/kg before procedure.

The patient lied supine with head turn to opposite side and ipsilateral arm by the side of the body. Under aseptic precautions needle was inserted posterolateral to the point where pulsations of subclavian artery were felt in downward, backward and inward direction. Injecting in the proximity of lower trunk was the most important factor in accomplishing a successful supraclavicular block. This was insured by paresthesia over fingers.

Sensory and motor blockade were assessed every 2 min after completion of injection till 30 min and then every 30 min after the end of surgery till first 12 h, thereafter hourly until the block had completely worn off. Sensory blockade of each nerve was assessed by pinprick. Onset time of motor blockade was defined as the time interval between the end of local anaesthetic injection and paresis in all of the nerve distributions. VAS was measured every hour after the end of surgery for 24 h.

Sensory block was graded as:

Grade 0- Sharp pin prick felt

Grade 1- Analgesia, dull sensation felt

Grade 2- Anaesthesia, no sensation felt

Motor block was assessed bilaterally using modified Bromage scale for upper extremities on three point scale

Grade 0- Normal motor function with full flexion and extension of elbow wrist and fingers

Grade 1 – ability to move fingers only

Grade 2- Complete motor blockade with inability to move the fingers.

At the end of the procedure the quality of blockade will be assessed according to the following numerical scale

Grade 4-(excellent)- No complaint from the patients

Grade 3-(Good). Minor complaint with need of analgesia but no need of sedation

Grade 2-(moderate). Complaint with need of analgesia as well as sedation

Grade 1(unsuccesful)- patient given general anaesthesia.

RESULTS

The demographic data in the two groups are presented in table 1.

Table 1: Demographic profile of participants

Parameters	Group A(n=40)	Group B(n=40)	t value		p value	
Age (years)	44.8±6.6	45.2±7.7	-0.24		0.8	
Height(cm)	166.6±7.7	164.9±7.04	1.03		0.3	
Weight(Kg)	62.1±5.2	63.5±6.2	-1.08		0.28	
Gender(M/F)	22/18	19/21	55% Male	45% Female	47% Male	53% Female
ASA(I/II)	19/21	18/22	47% I	53% II	45% I	55% II

Both groups were comparable in terms of age, gender, weight and ASA grade .

The onset and duration of sensory and motor blocks are shown in table 2.

Table 2: Table showing onset and duration of sensory and motor block and duration of analgesia in group A and B

Parameters	Group A	Group B	p value
Onset of sensory block (min)	14.7±1	15.1±0.96	0.07
Onset of motor block(min)	15.55±1.3	16.12±1.7	0.09
Duration of sensory block(min)	267.83±13.2	399.9±20.43	<0.0001*
Duration of motor block(min)	242.8±13.2	355.4±22.6	<0.0001*
Duration of analgesia(min)	297.24±8	372.96±27.97	<0.0001*

P<0.05 significant

The quality of block achieved in the two groups is shown in table 3.

Table 3 : Quality of block in group A and group B

GRADE	Group A(n=40)		Group B(n=40)	
IV	20	50%	18	45%
III	18	45%	21	52.5%
II	2	5%	1	2.5%
I	0	0	0	0

In group A 50% of patients achieved grade IV quality of block in comparison to 45% in group B which was not significant($p>0.05$).

31 patients required rescue analgesic(intramuscular diclofenac sodium injection) in group A compared to 27 patients in group B.

DISCUSSION

In this prospective, randomised trial we compared the effect of 1 ml of magnesium sulphate (150mg) in normal saline solution and same volume of placebo as an adjuvant to 30ml 0.50% ropivacaine in supraclavicular brachial plexus block. The onset and duration of sensory and motor block, the perioperative vitals and requirement of post operative rescue analgesic were also compared by us.

The demographic profile was similar in the two groups ($p > 0.05$, table 1) which provided us the uniform platform to evenly compare the results obtained.

The onset of sensory and motor blockade was prolonged in the magnesium group in our study (16.12 ± 1.7 min in group B versus 15.55 ± 1.3 min in group A) but the differences were statistically insignificant ($p = 0.07$). Previous studies using magnesium as adjuvant to local blocks have yielded different results in this regard. Like us Kasturi et al. [10] found that the use of magnesium as adjuvant to ropivacaine in supraclavicular brachial plexus block caused a delay in onset of sensory and motor block which was statistically insignificant. Similar results were observed by Khezri et al. [14] and Malleeswaran et al. [15]. However in contrast, Ekmekci et al. [16], while performing femoral nerve block, found significantly delayed onset of sensory block in the levobupivacaine, magnesium group than in the levobupivacaine group.

In our study, the duration of sensory block (399.9 ± 20.43 min in group B vs. 267.83 ± 13.2 min in group A) was significantly longer in the magnesium group than in the control group ($p < 0.001$). The duration of motor block (355.4 ± 22.6 min in group B, vs. 242.8 ± 13.2 min in group A) was also significantly longer in the magnesium group than in the control group ($P < 0.001$). These findings lend support to the observations of various earlier studies by Kasturi et al. [10], Nath et al. [17], Malleeswaran et al. [15] and Ekmekci et al. [16].

We found that the mean duration of analgesia attained was significantly longer in magnesium group than control group (372 ± 27.97 min in group B vs 297.24 ± 8 , $p < 0.001$) in our study. Consequently the patients of magnesium group required less rescue analgesia as compared to controls in the first 24h post operative period. Like our study Kasturi et al [10] also demonstrated a significantly higher mean duration of sensory block in patients receiving magnesium as an adjuvant [ref]. Patients in the magnesium group required significantly less rescue analgesia in their study also EL Shamaa et al. [18] also experienced that statistically much less amount (35.6 mg vs. 113.6 mg) of diclofenac sodium was administered as rescue analgesic in bupivacaine plus magnesium group, while comparing with bupivacaine plus normal saline group during femoral nerve block. They also found that less number of patients (9 vs. 30) in magnesium sulphate group asked for rescue analgesia.

Nausea was observed in three and two patients in group A and B, respectively. They needed no active management except increasing the fluid transfusion rate. The mean peri-operative

pulse rate, Systolic blood pressure and diastolic blood pressure were similar in the two groups.

Conclusion

We thus conclude that addition of 150 mg magnesium sulphate to ropivacaine 0.50% solution in supraclavicular brachial plexus block prolongs the duration of sensory and motor blockade and reduces the requirement of rescue analgesic in postoperative period with no significant adverse effects.

References

1. Bruce BG, Green A, Blaine TA, Wesner LV. Brachial plexus blocks for upper extremity orthopaedic surgery. *J Am Acad Orthop Surg.* 2012;20:38–47.
2. Vainionpää VA, Haavisto ET, Huha TM, Korpi KJ, Nuutinen LS, Hollmén AI, et al. A clinical and pharmacokinetic comparison of ropivacaine and bupivacaine in axillary plexus block. *Anesth Analg.* 1995;81:534–8.
3. Bazin JE, Massoni C, Groslier D, Fenies V, Bittar M, Schoeffler P. Brachial plexus block: Effect of the addition of sufentanil to local anesthetic mixture on postoperative analgesia duration. *Ann Fr Anesth Reanim.* 1997;16:9–13.
4. Kohli S, Kaur M, Sahoo S, Vajifdar H, Kohli P. Brachial plexus block: Comparison of two different doses of clonidine added to bupivacaine. *J Anaesthesiol Clin Pharmacol.* 2013;29:491–5.
5. Yadav RK, Sah BP, Kumar P, Singh SN. Effectiveness of addition of neostigmine or dexamethasone to local anaesthetic in providing perioperative analgesia for brachial plexus block: A prospective, randomized, double blinded, controlled study. *Kathmandu Univ Med J (KUMJ)* 2008;6:302–9.
6. Jarbo K, Batra YK, Panda NB. Brachial plexus block with midazolam and bupivacaine improves analgesia. *Can J Anaesth.* 2005;52:822–6.
7. Sirvinskas E, Laurinaitis R. Use of magnesium sulfate in anesthesiology. *Medicina (Kaunas)* 2002;38:695–8.
7. Agrawal A, Agrawal S, Payal YS. Effect of continuous magnesium sulfate infusion on spinal block characteristics: A prospective study. *Saudi J Anaesth.* 2014;8:78–82.
8. Do SH. Magnesium: A versatile drug for anesthesiologists. *Korean J Anesthesiol.* 2013;65:4–8.
9. Telci L, Esen F, Akcora D, Erden T, Canbolat AT, Akpir K. Evaluation of effects of magnesium sulphate in reducing intraoperative anaesthetic requirements. *Br J Anaesth.* 2002;89:594–8.

10. Mukherjee K, Das A, Basunia SR, Dutta S, Mandal P, Mukherjee A. Evaluation of Magnesium as an adjuvant in Ropivacaine-induced supraclavicular brachial plexus block: A prospective, double-blinded randomized controlled study. *J Res Pharm Pract.* 2014 Oct;3(4):123-9. doi: 10.4103/2279-042X.145387. PMID: 25535620; PMCID: PMC4262858.
11. Dogru K, Yildirim D, Ulgey A, Aksu R, Bicer C, Boyaci A. Adding magnesium to levobupivacaine for axillary brachial plexus block in arteriovenous fistule surgery. *BratislLekListy.* 2012;113:607–9.
12. Choi IG, Choi YS, Kim YH, Min JH, Chae YK, Lee YK, et al. The Effects of Postoperative Brachial Plexus Block Using MgSO₄ (4) on the Postoperative Pain after Upper Extremity Surgery. *Korean J Pain.* 2011;24:158–63.
13. Gunduz A, Bilir A, Gulec S. Magnesium added to prilocaine prolongs the duration of axillary plexus block. *RegAnesth Pain Med.* 2006;31:233–6.
14. Khezri MB, Yaghobi S, Hajikhani M, Asefzadeh S. Comparison of postoperative analgesic effect of intrathecal magnesium and fentanyl added to bupivacaine in patients undergoing lower limb orthopedic surgery. *ActaAnaesthesiol Taiwan.* 2012;50:19–24.
15. Malleeswaran S, Panda N, Mathew P, Bagga R. A randomised study of magnesium sulphate as an adjuvant to intrathecal bupivacaine in patients with mild preeclampsia undergoing caesarean section. *Int J ObstetAnesth.* 2010;19:161–6.
16. Ekmekci P, Bengisun ZK, Akan B, Kazbek BK, Ozkan KS, Suer AH. The effect of magnesium added to levobupivacaine for femoral nerve block on postoperative analgesia in patients undergoing ACL reconstruction. *Knee Surg Sports TraumatolArthrosc.* 2013;21:1119–24.
17. Nath MP, Garg R, Talukdar T, Choudhary D, Chakrabarty A. To evaluate the efficacy of intrathecal magnesium sulphate for hysterectomy under subarachnoid block with bupivacaine and fentanyl: A prospective randomized double blind clinical trial. *Saudi J Anaesth.* 2012;6:254–8.
18. ELShamaa HA, Ibrahim M, Eldesuky HI. Magnesium sulfate in femoral nerve block, does postoperative analgesia differ? A comparative study. *Egypt J Anaesth.* 2014;30:169–73.