Original article

Effect of I.V. magnesium on post operative analgesia following brachial plexus block

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Abstract:

Background and Aims: Magnesium has been found to be effective for postoperative analgesia. We aimed to study the efficacy and safety of iv magnesium for postoperative analgesia following brachial plexus block.

Methods: This prospective, randomized study was conducted in 60 patients. Ropivacaine 0.375%, 0.5 ml/kg was injected for plexus block. Group M (n=30) received magnesium sulphate bolus of 50 mg/kg body weight infused over 15 minutes just after giving brachial plexus block, and then a continuous infusion of magnesium sulphate at dose of 15 mg/kg body weight/hour for 6 hours continuing into postoperative period. Patient in control group C received equal volume of normal saline. Rescue analgesic in the postoperative period was provided by iv tramadol with a loading dose of 1mg/kg iv followed by incremental doses of 0.5 mg/kg every 20 minutes to a maximum dose of 3 mg/kg to both groups of patients.

Result: The mean duration of postoperative analgesia was 633.67 ± 30.11 minutes in Group M and 603.67 ± 30.22 minutes in Group C , and the difference was statistically significant. The total tramadol required in first 24 hours was 137.25 ± 16.77 mg in group M, compared to 150.6 ± 23.26 mg in group C. This difference was statistically significant.

Conclusion: Intravenous magnesium sulphate infusion decreased postoperative pain and analgesic requirements in postoperative period without producing any side effects. The onset and duration of block was not altered due to administration of magnesium.

Keywords: Magnesium, Postoperative analgesia, Brachial plexus

Introduction

Magnesium has antinociceptive effects in animal and human model of chronic pain. This effect is primarily based on the regulation of calcium influx and antagonism of the NMDA receptors. Post nociceptive central sensitization has been shown to depend on activation of dorsal horn NMDA receptors by excitatory neurotransmitters such as glutamate and aspartate. The role of magnesium for postoperative analgesia has been demonstrated in clinical studies[1,2] . We aimed to assess the efficacy and safety of iv magnesium for postoperative analgesia following brachial plexus block.

Methodology

This prospective, randomized study was conducted in Medical College Orthopaedics Operation Threatre from January to December, 2013. After approval of the institutional ethical committee, and obtaining informed written consent from 60 patients undergoing upper limb orthopaedic surgery under brachial plexus block were enrolled for the study. Patient with Physical status other than ASA I and ASA II, any emergency operation, history of cardiac

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and pulmonary disease, hepatic, renal or any metabolic disorders, Pregnancy were excluded from study.

Standard monitoring and iv cannula were attached before injection of anaesthetics. Supra clavicular brachial plexus block was performed with the help of nerve stimulator. Ropivacaine 0.375%, 0.5 ml/kg was injected for plexus block. These patients were randomly divided into 2 groups each consisting of 30 patients. Patients in group M received magnesium sulphate bolus dose of 50 mg/kg body weight infused over 15 minutes just after giving brachial plexus block, and then a continuous infusion of magnesium sulphate at dose 15 mg/kg body weight/hour for 6 hours continuing into postoperative period. Patient in control group, group C received equal volume of normal saline. Rescue analgesic in the postoperative period was provided by injection of tramadol with a loading dose of 1mg/kg iv followed by incremental doses of 0.5 mg/kg i.v. every 20 minutes to a maximum dose of 3 mg/kg to both groups of patients.

The time of onset for sensory blockade, defined as time between Injection of local anaesthetic and abolition of pinprick response was evaluated in four nerve areas (radial, ulnar, median and musculocutaneous) at every 3 minutes until 30 minutes after the injection. The block was judged failed if anesthesia was not present in 2 or more peripheral nerve distribution and such patients were excluded from the study.

For motor block, the inability to flex or extend the following joints: musculocutaneous nerve (flex elbow), median nerve (flex distal interphalangeal joint of 2nd finger), radial nerve (extend wrist), ulnar nerve (abduct 3rd and 4th fingers) was tested. Time of onset of motor block, defined as the time between injection of local anesthetic and in ability to move the joints was evaluated every 3 minutes and time to block atleast two major nerves was noted. The duration of sensory blockade, defined as the time between onset of action and return of pinprick response, was assessed every 30 minutes in at least 3 major nerve territory.

The duration of analgesia, defined as the time between the onset of action and the onset of pain, when the patients received the first dose of rescue analgesic.

The duration of motor blockade, was assessed every 30 minutes till the return of complete muscle power in at least 2 major nerve distributions. The duration of surgery and total amount of magnesium infused was noted.

Pain was assessed by standardised Visual analogue scale (VAS) at 0, 1, 3, 6, 9, 12, & 24 hour postoperative. Sedation score was assessed at same interval postoperatively using appropriate scale. (Ramsay sedation scale). VAS score of more than 3 was considered inadequate analgesia. Time to first dose of rescue analgesic and total amount of tramadol required during the first 24 hours postoperative was noted. Incidence of nausea, vomiting, and shivering was recorded in both groups during the first 24 hours. Serum magnesim level was measured preoperatively, immediate postoperatively, at 6 hours and 24 hours postoperatively. Any signs of hypermagnesaemia found during first 24 hours postoperative was noted and treated accordingly.

Result

The demographic profiles and duration of surgery were comparable among the two groups. (P >0.05. Table 1). The mean onset time of sensory block was similar in two groups. The mean duration of postoperative analgesia was 603.67 ± 30.22 minutes

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in Group C and 633.67 ± 30.11 minutes in Group M, and the difference was statistically significant (Table 2). The mean onset time and duration of motor block were similar in both group (Table 3). The total tramadol required in first 24 hours was 137.25 ± 16.77 mg in group M, compared to 150.6 ± 23.26 mg in group C. This difference was statistically significant. The visual analogue scale (VAS) scores were comparable in both the groups at 0, 1, 3, 6 hours postoperative. However at 9 and 12 hours postoperative, VAS scores were significantly lower in Group M compared to Group C. Serum magnesium levels were significantly raised at 0, 6 and 24 hours postoperative in Group M compared to Group C.

Sedation scores were similar in both groups at different time interval. The baseline haemodynamic variables like HR, MAP and SpO_2 were stable and comparable in both the groups. There were no significant changes in these parameters throughout the study in both groups. No complications or any other adverse events were eminent in either of the groups.

Discussion

The concept of preemptive analgesia was introduced in by Woolf who demonstrated through experimental studies that post injury pain hypersensitivity results via central mechanism[3]. Intense or repeated noxious stimuli, causes release of excitatory amino acids such as glutamate and aspartate in the dorsal horn. The action of the excitatory amino acids are mediated by NMDA and non- NMDA receptors. Activation of NMDA receptors, lead to Calcium entry into the cell and initiates a series of central sensitization such as wind up and long term potentiation in the spinal cord in the responses of cells to prolonged stimuli. Central sensitization has an important role for pain perception and is considered to be one of the mechanisms implicated in the persistence of post operative pain.

NMDA receptor antagonists such as ketamine, magnesium, MK801, thus have the potential to prevent the induction and maintenance of central sensitization. Magnesium blocks NMDA channels in a voltage dependent way, and addition of magnesium produces a dramatic reduction in NMDA induced currents. The finding of our study is similar to that of the study of Anbarci O et al, where they assessed the effects of postoperative magnesium infusion for 24 hours on duration of the block, sedation and postoperative analgesic consumption after brachial plexus block[4]. The postoperative infusion of magnesium sulphate did not prolong the duration of brachial plexus block. Tramer MR, et al (1996) found that patients treated with magnesium consumed less morphine in postoperative period[5]. Cumulative mean morphine doses after 48 hours postoperative were 65 mg in magnesium group and 91 mg in control group. Apan A, et al 2004 found that postoperative infusion of magnesium sulphate, to the patients undergoing surgery under spinal anesthesia, resulted in increase in the time to first analgesic requirement[6]. Also, total analgesic consumption was significantly less in patients receiving magnesium sulphate.

The hemodynamic parameters, pulse, mean arterial pressure, arterial saturation of oxygen (SpO_2) were monitored in both groups. The changes in these parameters were similar and there was no statistically significant difference between the groups.

The mechanism by which magnesium alters the postoperative analgesia is still not clear. The postulated theory is the antagonism of NMDA receptors. Magnesium is a non competitive antagonist of NMDA receptors. Another mechanism is by

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interfering with calcium influx and reduction in catecholamine release due to sympathetic stimulation.

Hammad Usmani et al (2007) hypothetzied that optimal timing and mode of administrationof magnesium is vital for ensuring adequate analgesic response[7]. In their study, the loading dose of magnesium sulphate was infused 15 minutes before induction of anaesthesia. This resulted in optimal levels of magnesium before inflicting painful stimuli.

Conclusion

It was observed that intravenous magnesium sulphate infusion decreased postoperative pain and analgesic requirements in postoperative period without producing any side effects. The onset and duration of block was not altered due to administration of magnesium

Table 1: DEMOGRAPHIC PROFILE

Demographic Profile	**Group C** **Mean ± SD**	**Group M** **Mean ± SD**
Age (Years)	33.03 ± 10.82	33.43 ± 9.83
Weight (Kg)	48.17 ± 5.06	48.43 ± 5.16
ASA Physical Status (I/II)	26/04	27/03
Gender (M:F)	17/13	21/9
Duration of Surgery (min)	93.33 ± 21.62	97.50 ± 22.31

Table 2:Characteristics of Analgesia

Duration (min)	Group C(n=30)	Group M (n=30)	P value
	No of patients (%)	No of patients (%)	
500 – 549	1 (3.33)	0	
550 – 599	7(23.33)	1(3.33)	
600 – 649	20 (66.67)	20(66.67)	
650 -699	2(6.67)	9(30)	
Mean duration	603.67± 30.22	633.67± 30.11	>0.05
Mean onset	12.1± 2.6	13.43 ± 2.9	<0.05

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Table 3:Characteristics of motor block

Duration (min)	Group C	Group M	P value
	No of patients (%)	NO of patients (%)	
350 -449	10 (33.33)	9 (30)	
450 -549	20 (66.67)	21(70)	
Mean duration	456 ± 44.84	471± 45.36	> 0.05
Mean onset	16.50 ± 2.33	15.60 ± 2.77	>0.05

Table 4: Changes in serum magnesium level (meq/ l)

Time	Group C	Group M	P value
Baseline	2.15 ± 0.21	2.11± 0.21	>0.05
0 post op	2.06 ± 0.20	3.95± 0.17	<0.05
6 hrs post op	2.00 ± 0.21	3.94 ± 0.16	<0.05
24 hrs post op	1.98 ± 0.21	2.81± 0.18	<0.05

Table 5: Changes in visual analogue score

Time	Goup C	Group M	P value
Baseline	1.81± 0.53	1.97 ± 0.06	>0,05
0 hrs post op	0	0	>0.05
1 hrs post op	0	0	>0.05
3 hrs post op	0	0	>0.05
6 hrs post op	0	0	> 0. 05
9 hrs post op	1.87 ± 1.11	1.14 ± 0.92	<0.05
12 hrs post op	2.42 ± 0.58	2.09 ± 0.58	<0.05
24 hrs post op	2.31 ± 0.90	2.43 ± 0.84	>0.05

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