Original Article

Effect of addition of magnesium to local anesthetics for peribulbar block: A prospective randomized double-blind study

ABSTRACT

Background: Magnesium sulphate has been used along with local anesthetics in different regional blocks and found to be effective in decreasing the time of onset of the block and increasing the duration of the block.

Objective: To evaluate the effect of addition of magnesium sulfate to standard local anesthetics mixture on the time for onset of the globe and lid akinesia for peribulbar block in ophthalmic surgeries.

Materials and Methods: Sixty patients with American Society of Anesthesiologists status I to III undergoing ophthalmic surgery under peribulbar block were included in this study. Patients were randomized into two groups. Both the groups received 4.5 ml of 2% lidocaine, 4.5 ml of 0.5% bupivacaine with150 IU hyaluronidase. Group NS received normal saline 1 ml in the peribulbar block and Group MS, magnesium sulfate 50 mg in 1 ml normal saline. The onset of akinesia, satisfactory block and complications were observed by an independent observer.

Results: Demographic data was statistically similar. In the Group NS at 3, 5, 10 and 15 min after the block, complete akinesia was seen in 0, 2, 11 and 28 patients respectively. In the Group MS, at 3, 5, 10 and 15 min after the block, complete akinesia was seen in 13, 23, 27 and 28 patients respectively. Patients received magnesium sulfate showed the statistically significant rapid onset of lid and globe akinesia than the control group till 10 min ($P < 0.000$). None of the patients needed a supplementary block and had complications during the surgery.

Conclusion: Addition of 50 mg of magnesium sulfate to the lidocaine-bupivacaine mixture for peribulbar block decreases the onset of akinesia without any obvious side effect.

Key words: Adjuvants; akinesia; analgesia; magnesium sulfate; peribulbar block

Introduction

Regional anesthesia is a preferred technique for ophthalmic surgery. It is safe, inexpensive and provides efficient ocular anesthesia for ophthalmic surgery. Among regional blocks, peribulbar block is safer in comparison to retrobulbar block due to a lesser incidence of serious complications such as brainstem anesthesia, globe perforation, and retrobulbar hemorrhage.[1] However, the development of ocular akinesia with peribulbar block takes longer time in comparison to retrobulbar block, and the occurrence of inadequate analgesia is also more frequent in peribulbar block.[2,3]

In order to enhance the onset of akinesia and increased tissue diffusion, additives like hyaluronidase,[4]

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adrenaline,[5] clonidine,[6] corticosteroids,[7] sodium bicarbonate[8] and neuromuscular blocking agents[9-11] have been used in peribulbar block. These agents are also not devoid of side-effects like allergic reaction, bradycardia, sedation, dryness of mouth, systemic neuromuscular blockade, etc. Until date, no one adjuvant is ideal for peribulbar block.

Magnesium is a physiological calcium channel blocker and noncompetitive antagonist of N-methyl-D-aspartate (NMDA) receptors.[12] It has been used with a local anesthetic solution in different regional anesthesia technique to decrease the onset time of block and to increase the quality and duration of anesthesia.[13-17]

There is only one study in the literature using magnesium sulfate as an adjuvant with local anesthetic for peribulbar block.[18] The current randomized, double-blinded, prospective study was designed to evaluate the effect of addition of magnesium sulfate to standard local anesthetics mixture on the time for onset of globe and lid akinesia with peribulbar block in ophthalmic surgeries.

Materials and Methods

The study was approved by the Institutional Ethics Committee and was registered with the Clinical Trials Registry of India (CTRI number: CTRI/2013/03/003483). Sixty American Society of Anesthesiologists (ASA) status I to III adults, aged 18-75 years scheduled for elective ophthalmic surgery were included in this prospective, randomized, double-blind trial. Patients are refusing to participate in the study, having mental retardation, history of bleeding disorder, allergy to local anesthetics and severe cardiac/respiratory disease were excluded from the study. An informed written consent was obtained from all the patients prior to the initiation of the study.

Patients were kept nil per orally according to standard protocol (6 h for solids, and 2 h for clear fluids) and received mydriatic or mitotic eye drops as per requirement of the surgery. No sedative premedication was administered in the preoperative period. In the operating room, an intravenous line was secured and standard monitoring (heart rate, electrocardiography, oxygen saturation, and noninvasive blood pressure) were applied to all the patients. Patients were randomized into two groups (30 patients in each group) using a computer-generated randomization table. Both the groups received a total of 10 ml solution for the peribulbar block. Patients of Group NS received a mixture of 4.5 ml of 2% lidocaine, 4.5 ml of 0.5% bupivacaine and1 ml saline (total 10 ml) while Group MS patients received a mixture of 4.5 ml of 2% lidocaine, 4.5 ml of 0.5% bupivacaine and 50 mg of magnesium sulfate in 1 ml of saline (total 10 ml) for the peribulbar block. Hyaluronidase 150 IU was added to the solution in each group.

The study solution for peribulbar block was prepared by the anesthesiologist who was not involved in the study. All the blocks were performed by an experienced ophthalmologist, who was blinded to the drugs given in the block. Peribulbar block was administered with a 26 gauge, ½ inch needle. The first injection was given just superior to the infra orbital rim in the inferotemporal quadrant and second injection was given just lateral to the supra-trochlear notch. Time interval between the two injections was minimal (<1 min). Gentle massage was done for 2 min after the injection. Eye movements (both the movement of the rectus muscles and the lid movements) were assessed by an anesthesiologist at 3, 5, 10, 15 and 20 min after the block. At the end of 20 min, if there was any residual eye movement, supplementary injection containing 4 ml of the standard local anesthetic combination was administered using infero-temporal approach. The degree of globe and lid akinesia was assessed on a scale of 0-2 by the method described by Sarvela.[19] (0 = complete akinesia, 1 = partial akinesia and 2 = no akinesia) [Table 1].

The occurrence of complete akinesia was considered as satisfactory block. Time for complete akinesia was recorded in all the patients. If the patient experienced pain during the surgery, subtenon's block was administered, and the patient was excluded from the study. After completion of the surgery, the return of the eye movements was assessed every 15 min. Any side effect or complication (hemorrhage, globe perforation, brain stem anesthesia) of the block was recorded, and appropriate management was done according to standard protocol. At the end of surgery, surgeons satisfaction score using a verbal satisfaction score scale of 0 (total dissatisfaction) to 10 (total satisfaction) was recorded.

Data were recorded using a standardized data collection sheet and analyzed using the statistical software STATA-9

Table 1: Scoring system of global akinesia

Akinesia of extra ocular muscles including levator muscle
0: 0-1 mm movement in 1 or 2 main directions or 0-4 mm movement in levator muscle
1: 1 mm movement in >2 main directions, 2 mm movement in any main direction, or >4 mm movement in levator muscle
2: ≥2 mm movement in any main direction or 2 mm movement in 2 or more main directions

(Stata Corp LP, College Station, TX, USA). A $P < 0.05$ was considered significant in all cases.

Results

The demographic characteristics (age, sex, weight) and ASA physical status were comparable between the two groups. Both the groups were also comparable in terms of type of surgery and duration of surgery [Table 2].

The number of patients having complete globe and lid akinesia at 3, 5 and 10 min was more in the Group MS in comparison to the Group NS, which was statistically significant [Table 3]. The globe and lid akinesia was not significantly different between the groups at 15-20 min. All patients in both the groups had a satisfactory block at the end of 20 min. No patient required any supplemental injection for inadequate block.

In the postoperative period, none of the patients in either group complained of pain during the surgery. There was no major complication in any of the patients in this study. Three patients in the Group NS and four patients in the Group MS had chemosis. Surgeon's satisfaction score was similar with regards to the quality of anesthesia and surgical conditions in both the groups.

Table 2: Patient demographics

Demographic parameters	Group NS (n = 30)	Group MS (n = 30)	P
Age (years)* mean (SD)	45.06 (16.68)	51.2 (14.52)	1.52
Sex (male:female)**	23:7	20:10	0.57
Weight (kg)* mean (SD)	62.93 (8.03)	63.4 (6.94)	0.26
ASA physical status (I/II)**	27/3	23/7	0.17
Type of surgery*** (anterior chamber/posterior chamber)	18/12	12/18	0.12

*Student's *t*-test, **Fisher's exact test, ***Pearson Chi-square test. SD: Standard deviation; ASA: American Society of Anesthesiologists

Table 3: Globe and lid akinesia and surgeon satisfaction score

Akinesia and surgeon satisfaction score	Group NS (n = 30)	Group MS (n = 30)	P
Globe and lid akinesia score* (excellent [0]/adequate [1]/poor [2])			
3 min	0/4/26	13/14/3	0.000
5 min	2/21/7	23/6/1	0.000
10 min	11/19/0	27/3/0	0.000
15 min	28/2/0	28/2/0	1.00
20 min	30/0/0	30/0/0	1.00
Need for supplemental injection	0	0	
Pain during surgery	0	0	
Surgeon satisfaction score	9 (8-10)	9 (8-10)	1.00

*Pearson Chi-square, Fisher's exact test

Discussion

Peribulbar block has been used widely for ophthalmic surgery as it is safer than a retrobulbar block. The time for onset of akinesia with peribulbar block is much longer in comparison to retrobulbar block,[2] which may lead to a delay to start the surgery. The incidence of inadequate analgesia is also more frequent with peribulbar block[2] in comparison to retrobulbar block, which may lead to the requirement of supplementary injection before the start of surgery or intraoperatively.

Various adjuvants, that is, clonidine, fentanyl, atracurium, rocuronium, corticosteroids have been used to enhance the onset and duration of akinesia and quality of the peribulbar block. Use of these adjuvants is also not devoid of side-effects such as allergic reaction, bradycardia, sedation, dryness of mouth, systemic neuromuscular blockade, etc.

We planned to use magnesium as an adjuvant with local anesthetic agents for peribulbar block. Magnesium sulfate is the fourth most important cation in the human body and needed for enzymatic reactions. Magnesium has been used previously in neuraxial as well as peripheral nerve blocks for earlier onset by blocking calcium influx and noncompetitively antagonizing NMDA receptor channels.

In the present study, the onset of globe and lid akinesia was statistically faster in the Group MS as compared to the Group NS in the first 10 min after the block. There was no difference for the globe and lid akinesia between the two groups at 15 and 20 min. All patients in both the groups had satisfactory peribulbar block at 20 min. El-Hamid[18] also found the significant rapid onset of globe and lid akinesia in the magnesium group patients compared with the clonidine group patient as an adjuvant to local anesthetic in peribulbar block for posterior segment eye surgeries. In our study, both anterior and posterior segment surgeries were included.

Gunduz *et al*.[17] found prolongation of sensory and motor block in axillary nerve block without any side effects when 150 mg magnesium was added to prilocaine.

Dogru *et al*.[20] also found statistically decreased motor and sensory block onset times by the addition of magnesium to levobupivacaine for axillary brachial plexus block in chronic renal failure patients scheduled for arteriovenous fistula surgery.

In contrast Lee *et al*.[21] observed no difference in onset times and durations of sensory and motor blocks in magnesium sulfate group and normal saline group with 0.5% bupivacaine

with epinephrine in interscalene nerve block for arthroscopic rotator cuff repair. They only found statistically significant prolongation of analgesia in the magnesium group than in the saline group.

Narang *et al*.[22] observed that the addition of magnesium sulfate as adjunct to lignocaine for total intravenous anesthesia for upper limb surgery hastened the onset of sensory and motor block and decreased tourniquet pain.

When magnesium was compared with clonidine as an adjunct for epidural bupivacaine, the onset of anesthesia was rapid, but the duration of analgesia was shorter in magnesium group in comparison to clonidine group.[15] Sedation was seen in the clonidine group. The author established that magnesium is predictable and safe adjunct to epidural bupivacaine. El-Hamid[18] also found the longer duration of peribulbar block in the patients receiving clonidine with local anesthetic in comparison to the patients receiving magnesium.

In the present study, there were no additional complications apart from chemosis which may be attributed to peribulbar block[23] in both the groups. Magnesium is safe drug, and most of the studies showed no side effects with its use at the single dose of 50 mg.

Conclusion

The addition of magnesium sulfate to the local anesthetic mixture results in the earlier onset of akinesia and establishment of suitable conditions to start the ophthalmic surgeries. Magnesium sulfate does not cause any side-effect at given dose and saves time in a busy ophthalmic theater.

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Conflicts of interest
There are no conflicts of interest.

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