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MAGNESIUM SULPHATE AS AN ADJUNCT TO LOCAL ANAESTHESIA FOR PERIBULBAR BLOCK IN KERATOPLASTY.

Ophthalmology

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ABSTRACT

Purpose: To evaluate the effect of addition of magnesium sulphate to standard local anaesthetic mixture for peribulbar block in cases of keratoplasties which require increased surgical time. **Setting:** Tertiary care hospital **Design:** Prospective, interventional, randomized, double blinded study **Methods:** 50 patients with various corneal diseases requiring full thickness or lamellar keratoplasty under peribulbar block were included in this study. Patients were randomised into two groups. Both the groups received 3.5 mL of 2% lidocaine, 2.5 mL of 0.5% bupivacaine with 150 IU hyaluronidase. Group NS received 1 mL normal saline and Group MS received 50 mg of magnesium sulphate in 1 mL of normal saline as the adjunct. The onset of akinesia, satisfactory block and repeat block requirement were assessed by independent observer. **Results:** In the study group, 23 patients (92%) did not require any supplemental injection at 30 minutes after the commencement of surgery. 2 patients (8%) required additional 2mL of 2% lignocaine at 20 minutes ($p < 0.05$). In the control group, 12 patients (48%) did not require any supplemental injection. 10 patients (40%) required supplemental injection of 2ml of 2% lignocaine, 5 minutes after the commencement of surgery as total akinesia was not achieved and patient experienced pain. 3 patients (12%) required supplemental injection at 30 minutes as the effect of block had begun to wane. The patient satisfaction score and surgeon satisfaction score was significantly better in the study group ($p <0.005$). **Conclusion:** Magnesium sulphate significantly reduces the need for supplementary block in patients undergoing keratoplasty without altering the onset of anaesthesia and safety profile in a significant manner.

KEYWORDS

Magnesium sulphate; Peribulbar block; Local anaesthesia; Keratoplasty

INTRODUCTION:

Corneal blindness is a major cause of burden on health care resources worldwide.[1] Full thickness andlamellar keratoplasty aids in the restoration of vision in these cases. It may be performed under local or general anaesthesia depending on patient preference and cooperation. Local anaesthesia, peribulbar block, is commonly used.

Performing ophthalmic surgeries under local anaesthesia requires anaesthesia and akinesia to ensure a cooperative patient and ideal operating conditions for the surgeon. Peribulbar block is a popular choice of regional anaesthesia in which the needle does not penetrate the cone formed by extraocular muscles.[2]It has several advantages over another commonly used technique of regional anaesthesia, retrobulbar block where there is intraconal injection of the anaesthetic agent. These include lesser risk of perforation of globe, optic nerve and ophthalmic artery, avoidance of retrobulbar haemorrhage and brainstem anaesthesia. Many times, peribulbar block does not take proper effect despite using proper technique and multiple injections. Therefore, various adjuvants have been tried and shown to improve the final outcome and to reduce the total amount of block that needs to be injected in peribulbar space in order to reduce the risk of rise in intraocular pressure. This is a major concern in full thickness keratoplasty with a potential to cause choroidal rupture. Adjuvants that have been used include clonidine, adrenaline, sodium bicarbonate, magnesium, opioids and neuromuscular blockers.[3]-[6]

Magnesium is a physiological calcium channel blocker and a non-competitive NMDA receptor antagonist whose anti-nociceptive action has been demonstrated in human and animal models.[5] Magnesium interferes with the calcium influx at the opioid receptors thereby increasing the nociceptive threshold.[7] Several studies show that the addition of magnesium to local anaesthetic for neuraxial anaesthesia prolongs the duration of anaesthesia and improves the quality of analgesia. There is a paucity of studies regarding the effect of magnesium on local anaesthetics used for peribulbar block.

METHODS:

This prospective, randomized double blind study was conducted at a tertiary care hospital in South India. Awritten informed consent was obtained from the participants of the study. The tenets of Declaration were abided to with utmost regard. Individuals who failed to give consent, who had prior history of allergy to the components of local anaesthesia, who had history of coagulation disorders or severe cardiac, respiratory, renal diseases and those who were not fit for surgery under local anaesthesia were excluded from the study. No medication (sedative agents) was given prior to the block.

3.5 ml of 2% lignocaine is mixed with 2.5 ml of 0.5% bupivacaine and 150 IU of hyaluronidase to prepare the anaesthetic mixture.

Patients undergoing keratoplasty under peribulbar block were randomized into two groups using a computer-generated list. Group NS receives 1 ml of normal saline while group MS receives 50 mg of magnesium sulphate in 1 mL of normal saline as an adjunct to the peribulbar block. A single certified person who is blind to the study is appointed to give the block in all patients.

After instilling topical anaesthesia, a 24G needle is inserted in the inferotemporal part of lower orbital rim, at the junction of medial 2/3 and lateral 1/3 to administer 4 ml of block and a second injection of 3 ml is made lateral to the supratrochlear notch.

A gentle massage or orbital compression is given for two minutes. The primary outcome measure was repeat block requirement assessed by an independent observer. The secondary outcome measures were onset of akinesia and duration of surgery.The patient and surgeon satisfaction at the end of surgery was assessed using Likert scale.

Statistical analysis: Descriptive and inferential statistical analysis has been carried out using computer software SPSS trial version 23 and primer. Qualitative data were expressed as mean and percentages, and quantitative data as mean, median, or standard deviation. The difference in proportion was analysed using the Chi-square test. The difference in means among the groups was analysed using the Student's t-test. The significance level for tests was determined as 95% ($P < 0.05$).

RESULTS:

50 patients recruited in the study were randomised into two groups. The age and sex distribution was found to be identical between the two groups ($P>0.05$)[Table 1].

Table 1: Demographic data and need for supplemental injections

Variables	GROUP MS	GROUP NS	P-Value
Age (years) Mean (SD)	49.72±12.65	46.36±13.47	0.37
Male: Female	17:8	15:10	0.77

Type of surgery			0.53
Penetrating keratoplasty	17	19	
Lamellar keratoplasty	8	6	
Number of supplemental injections***			0.0008*
At 5 minutes	0	10	
At 10 minutes	0	0	
At 20 minutes	2	0	
At 30 minutes	0	3	

a Student's t-test
b Fischer's exact test
c Chi-square test
*Statistically significant

The onset of anaesthesia and duration of surgery were not found to be significantly different in either group.In group MS, 23 patients (92%) did not require any supplemental injection at 30 minutes after the commencement of surgery. 2 patients (8%) required additional 2mL of 2% lignocaine at 20 minutes.

In group NS, 12 patients (48%) did not require any supplemental injection. 10 patients (40%) required supplemental injection with 2ml of 2% lignocaine, 5 minutes after the commencement of surgery as total akinesia was not achieved and patient experienced pain. 3 patients (12%) required supplemental injection at 30 minutes as the effect of block had begun to wane.

Thus, the total volume of block required in Group MS was lesser than the control group thus reducing the risk of rise in intraocular pressure during the surgery. This further reduces the risk of choroidal rupture which a great boon to the corneal surgeon.

The onset of anesthesia was not found to be significantly different in each of the groups. We used hyaluronidase in both the groups, which might have had some effect even in the Placebo group leading to a not so significant difference between the two.

The study group had significantly higher patient satisfaction in comparison with placebo group with more number of patients rating the procedure to have been comfortable. (Table 2)

Table 2: Patient Satisfaction

Patient satisfaction	Group MS		Group NS		P -value
	Number	Percentage	Number	Percentage	
Completely comfortable	9	36%	4	16%	0.11
Quiet comfortable	12	48%	4	16%	0.02*
Slight discomfort	3	12%	12	48%	0.006*
Painful	1	4%	4	16%	0.16
Very painful	0	0%	1	4%	0.32

*Statistically significant

Surgeon's satisfaction was significantly better with regards to the quality of anesthesia and surgical conditions in the study group. (Table 3)

Table 3: Surgeon satisfaction

Surgeon satisfaction	Group MS		Group NS		P-value
	Number	Percentage	Number	Percentage	
Completely satisfied	20	80%	12	48%	0.02*
Dissatisfied	0	0%	0	0%	0.00
Moderately satisfied	3	12%	5	20%	0.45
Satisfied	2	8%	8	32%	0.03*
Slightly dissatisfied	0	0%	1	4%	0.32

*Statistically significant

DISCUSSION:
The total volume of block injected is a crucial factor during peribulbar anaesthesia. If the amount of fluid injected in the peribulbar space is more, it would lead to increased intraocular pressure (IOP). It is important to ensure that the IOP is maintained at a low-normal level before an incision is made. As soon as the sclera is incised, the IOP equates with the atmospheric pressure. Therefore, if the pressure is high, the intraocular contents, namely the iris, lens, vitreous and retina may be expelled out through the wound.[8] Sudden decompression of a hypertensive eye may also increase the risk of rupture of the short posterior ciliary artery in the choroid, thus producing expulsive hemorrhage in the eye.[9]

Thus, it is crucial to limit the volume of peribulbar block injected in order to maintain the IOP at a low-normal level.

Various adjuvants have been experimented with to achieve the goals of satisfactory akinesia and analgesia to ensure maximum patient cooperation while undergoing surgeries under local anaesthesia. However, most of these adjuvants carry the risk of side effects and sometimes severe ones making them unsuitable for use. Studies have been done previously to study the effect of addition of magnesium to various neuraxial as well as peripheral nerve blocks.

The mechanisms of analgesic and anaesthetic properties of magnesium are yet to be fully elucidated. However, it is found to be a non-competitive antagonist at NMDA receptor, a ligand-gated calcium channel which generates excitatory post-synaptic potentials at glutaminergic neurons. The sustained activation of the receptor promotes intracellular signalling that culminates in long-term synaptic plasticity, wind up phenomenon and central sensitization. Magnesium being an antagonist, blocks this central sensitization.[10]

Although magnesium is not a primary analgesic by itself, it enhances the action of the more established analgesics as an adjuvant. The role of magnesium for perioperative analgesia has been investigated by many authors and reported to be effective in perioperative pain treatment by blunting the somatic, autonomic and endocrine reflexes provoked by noxious stimuli.[10]-[12] Further, magnesium acts as a calcium channel blocker at presynaptic nerve terminals and decreases acetylcholine release at the motor endplate, which diminishes muscle fibre excitability and reduces the amplitude of endplate potential. This results in the potentiation of neuromuscular blockade by a nondepolarizing agent thereby bestowing the property of akinesia to magnesium.[13]

Sinha R et al[3], observed from their study on the effect of addition of magnesium for peribulbar block in individuals undergoing anterior and posterior segment ophthalmic surgery that the onset of lid and globe akinesia was faster in the group receiving magnesium sulphate adjuvant than the group receiving normal saline for the first 10 minutes. There was no statistically significant difference between the two groups at 15 and 20 minutes and satisfactory akinesia is achieved by both the groups at 20 minutes. Magnesium sulphate does not cause any side effect at the dose used and is considered a safe drug.

El Hamid et al[14], observed that in patients undergoing posterior segment eye surgeries, those receiving magnesium sulfate showed a significantly rapid onset of lid and globe akinesia than patients receiving clonidine as adjuvant. Patients receiving clonidine showed a significantly prolonged duration of lid and globe akinesia than the magnesium group. The study established that magnesium was a predictable and safe adjunct to local anaesthesia for peribulbar block for rapid onset of anaesthesia.

Turan et al[15], conducted a study to evaluate the effect of magnesium, when added to lidocaine for IV Regional Anaesthesia [IVRA], on tourniquet pain. They concluded that the addition of magnesium improves the speed of onset and quality of anaesthesia, decreases tourniquet pain and intra-operative and post-operative analgesic consumption. It was also found that magnesium does not cause significant side effects.

Gunduz et al[16], found that the addition of magnesium sulphate to 2% prilocaine for axillary brachial plexus block provided marked prolongation of sensory and motor blockade.

Study by Elsharkawy RA et al[17], on obstetric patients showed that the magnesium group had a faster onset of sensory and motor block and a better analgesic profile in comparison with the placebo group. In another study, when magnesium was compared with clonidine as an adjunct for epidural bupivacaine, onset of anaesthesia was rapid, but

the duration of analgesia was shorter in the magnesium group in comparison to the clonidine group. Sedation was seen in the clonidine group.

In contrast to the above studies, Lee et al[5] studied the effect of addition of magnesium to 0.5% bupivacaine with epinephrine in interscalene nerve block for arthroscopic rotator cuff surgeries. No difference was found in the onset time and duration of sensory and motor blocks. A statistically significant prolongation of analgesia was found in the magnesium group in comparison with the saline group. Thus, further studies are required to confirm the role of magnesium sulphate in peribulbar anaesthesia.

We had a few limitations to our study. We did not study the persistence of the effect of anesthesia after the surgery. It will be interesting to know whether patients with magnesium sulphate injection are more comfortable and stable in the postoperative period. A greater sample size would yield more information regarding the need for supplementary block.

From our study, we conclude that magnesium sulphate can be safely used as an additive to peribulbar block as it reduces the requirement for supplementary block that is needed during a complex procedure such as keratoplasty. This can prove to be extremely useful to the surgeon since lower IOP, especially while performing crucial steps during keratoplasty surgery, can present a more safe and comfortable environment to the surgeon.

However, more studies are required to further assess the safety and efficacy of magnesium sulphate in patients undergoing penetrating keratoplasty.

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