

Magnesium sulphate versus Dexmedetomidine as adjuvants for local anesthetics in peribulbar block for eye surgeries: Clinical comparative study

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ABSTRACT

Background: Regional anesthesia is a preferred technique for ophthalmic surgery. It is safe, inexpensive and provides efficient ocular anesthesia for ophthalmic surgery. It is associated with less hemodynamic instability, less respiratory depression, better postoperative pain relief, and less nausea and vomiting compared to general anesthesia. Among regional blocks, peribulbar block is safer in comparison with retrobulbar block due to a lesser incidence of serious complications such as brain stem anesthesia, globe perforation, and retrobulbar hemorrhage.

Objective: The aim of the study was to compare the safety and efficacy of the use of Magnesium sulfate versus that of Dexmedetomidine as an adjuvant to the local anesthetic in peribulbar anesthesia for inducing optimal operating conditions for eye surgery in terms of akinesia (as a primary end point), analgesia, incidence of complications, as well as patient and surgeon satisfaction (as secondary end points).

Patients and Methods: The present study included 50 patients (females and males) aged 20-80 years. Materials: Anesthetic drugs, Needles size: 25 gauge, Intravenous cannula 22 G, Drugs for premedications: intravenous midazolam (5mg/ml, Mediatech, Amoun, Egypt) (0.01mg/kg) and Fentanyl Citrate (50µg/ml, Fentanyl- Janssen, Belgium) (25 µg) was administered 5 minutes before the block, Monitors for vital signs registration were done for each of the following: Electrocardiograph (ECG), non-invasive blood pressure (NIBP), heart rate (HR) and oxygen saturation (SpO₂), respiratory rate (RR), Anesthetic machine, resuscitation equipment and drugs.

Results: The current study was carried on 75 patients divided into Three equal groups: first group (control group), second group (dexmedetomidine group) and third group (magnesium sulphate group). All patients were scheduled for surgery.

Conclusion: Addition of 50 mg of magnesium 10% or 15 mic of dexmedetomidine to local anesthetic mixture for peribulbar anesthesia in the operations of phacoemulsification of cataract and intraocular lens implantation accelerated onset of globe anesthesia, akinesia of the globe and the lid, prolonged the duration of globe akinesia, lid akinesia, time to 1st analgesic request, and enhanced the satisfaction of the patients and quality of the operative conditions.

Key Words: Magnesium sulphate, Dexmedetomidine, local anesthetics, peribulbar block, eye surgeries

INTRODUCTION

Regional anesthesia is a preferred technique for ophthalmic surgery. It is safe, inexpensive and provides efficient ocular anesthesia for ophthalmic surgery. It is associated with less hemodynamic instability, less respiratory depression, better postoperative pain relief, and less nausea and vomiting than general anesthesia⁽¹⁾.

Among regional blocks, peribulbar block is safer in comparison with retrobulbar block due to a lesser incidence of serious complications such as brain stem anesthesia, globe perforation, and retrobulbar hemorrhage⁽²⁾.

Peribulbar block is a much simpler, rapid, and safe technique; especially in elderly patients who have multiple systemic diseases such as diabetes or cardiovascular disease that may limit the use of general anesthesia⁽³⁾.

Peribulbar anesthesia is widely used for cataract surgery. However, it has the disadvantages of a slow onset of orbital akinesia and the frequent need for block supplementation. To overcome these limitations, many adjuvant drugs such as

adrenaline, sodium bicarbonate, and hyaluronidase have been added to the local anesthetic mixture used for peribulbar block to augment its efficacy and hasten its speed of onset. However, their effects were variable⁽²⁾.

These agents are also not devoid of side-effects like allergic reaction, bradycardia, sedation and dryness of mouth, etc. Until date, no one adjuvant is ideal for peribulbar block⁽⁴⁾.

Magnesium sulfate has been used for many years on an empirical basis to control convulsions in patients with pre eclamptic toxemia. Magnesium ions are essential for many biochemical reactions, and a deficiency may produce clinically important consequences. Many of its pharmacological properties have only recently been appreciated (like its action as bronchodilator and its sedative effect)⁽⁵⁾.

Magnesium is a physiological calcium channel blocker and noncompetitive antagonist of N-methyl-D-aspartate (NMDA) receptors.

Magnesium has been used with a local anesthetic solution in different regional anesthesia

technique to speed the onset time of block and to increase the quality and duration of anesthesia⁽⁴⁾.

Dexmedetomidine is a centrally acting, highly selective α_2 -agonist that has been used as an additive to local anesthetics in peripheral nerve block, brachial plexus block, and subarachnoid anesthesia to shorten the onset and prolong the duration of analgesia⁽⁶⁾.

Dexmedetomidine has some pharmacological advantageous characteristics as it achieves more hemodynamic stability especially for patients with cardiovascular diseases, compared to other vasoconstrictors such as epinephrine. It is potent as a new safety adjuvant compared to LAs. It is preservative free and has no added chemicals. Dexmedetomidine may be used to improve the reliability and efficacy of regional anesthesia as it is useful in peripheral nerve blocks in patients with chronic pain⁽⁷⁾.

PATIENTS AND METHODS

I- Patients:

The present study included 50 patients (females and males) aged 20-80 years old. Informed written consent received from all patients after approval of Al-Azhar University ethical committee. Patients were randomly allocated into two equal groups (25 patients in each group).

Group O (control group): were undergone peribular block using local anesthetic + 0.9% saline (1 ml).

Group M: were undergone peribular block using local anesthetic + 50 mg magnesium sulfate in 1 ml of 0.9% saline.

Group D: were subjected to peribular block using local anesthetic + 15 μ g dexmedetomidine in 1 ml saline.

Study design: prospective, randomized controlled, single blinded study.

Inclusion criteria: Age: (20-80) years. Both genders are eligible. ASA class (I, II or III) patients. Axial eye length ranging from 22 to 28 mm.

Exclusion criteria: Patients refusal. Local sepsis. Trauma or perforated globe. Patients with hypersensitivity to local anesthetics. Patients on anticoagulants or prolonged coagulation profile (INR not more than 2.5). Patients with inability to lay flat, intractable cough, communication barrier (language, deafness) and neurological diseases.

Materials

Anesthetic drugs: Topical anesthetic: Benoxinate HCl drops 0.4% (Benox, Epico, Egypt). - Lidocaine HCl 2% (Debocaine, AL-Debeikypharma, Egypt). Bupivacaine HCl 0.5% (Bucain, DeltaSelect, Germany). -Hyaluronidase (Wydase, 15IU/ml, Wyeth, Lab, Philadelphia P). -Magnesium sulphate. Dexmedetomidine. Needles size: 25 gauge. Intravenous cannula 22 G. was inserted in the dorsum of the hand (preferred site) for intravenous access and sedation to the patients. Drugs for premedications: intravenous midazolam (5mg/ml, Mediathetic, Amoun, Egypt) (0.01mg/kg) and Fentanyl Citrate (50 μ g/ml, Fentanyl- Janssen, Belgium) (25 μ g) was administered at 5 minutes before the block. A nasal catheter was used for humidified oxygen supply at a rate of 2 litre/min. Monitors for vital signs: Electrocardiograph (ECG), non-invasive blood pressure (NIBP), heart rate (HR) and oxygen saturation (SpO₂), respiratory rate (RR). Anesthetic machine, resuscitation equipment and drugs. One ml plastic syringe with 29 G. needle filled with 1 ml of lidocaine 2% for local infiltration of the skin. 10 ml plastic syringe with 25G needle with a length of 25 mm needle filled with equal volume of lidocaine 2% (4.5ml) and bupivacaine 0.5% (4.5ml) with 15 I.U. /ml of hyaluronidase.

Techniques

Patient Position and general preparation

for all patients: The patients were at a comfortable state and soft pads are placed under the pressure areas. All patients were placed in supine position with their head resting on a small pillow and were asked to look in the primary gaze position. The face were swabbed with an appropriate cleansing solution. Each stage of the block was accompanied by verbal contact with the patient.

Painless local anesthetic technique:

“Painless local anesthetic solution” was injected in the inferotemporal quadrant. After gently retracting the lower eyelid with a finger, the tip of needle enters inferotemporally just posterior to posterior tarsal plate with the shaft of the needle arranged tangentially to the globe. Following test aspiration, the initial injection is 1ml “painless local”

All patients in each group received (9ml) of a mixture containing 2% lidocaine and 0.5% bupivacaine in combination with 150 IU hyaluronidase and 1 ml of additive in saline for (magnesium sulphate or dexmedetomidine).

After needle insertion, all patients asked to move their eyes in the four directions to exclude needle penetration. A negative aspiration was demonstrated before any local anesthetic injection to prevent intravascular injection. The injection of LA was slowly to avoid the oculocardiac vagal reflex that can occur with increased intra-orbital pressure.

A second area, injection of the study drug was performed at medial canthus peribulbar.

Gentle orbital compression was then performed for 1 min to aid in the diffusion of the local anesthetic mixture and also to soften the eye before surgery.

Manual pressure was done by repeated gentle pressure of two fingers 15 second to help distribution of the anesthetic solution all over the orbit and removed 5 second to avoid orbital ischemia

There are 3 groups the patients were divide randomly into two groups (25 patients in each group) and according to the received medications, they were received:

Classic controlled group (o): (25patients).

They received 9 ml of the local anesthetic: 4.5 ml of 0.5% bupivacaine and 4.5 ml of 2% lidocaine mixed with hyaluronidase (150 U) and 1ml of normal saline which was divided equally in both inferotemporal and medial canthus areas.

Magnesium sulphate group(m): (25 patients).

They received 9 ml of the local anesthetic: 4.5 ml of 0.5% bupivacaine and 4.5 ml of 2% lidocaine mixed with hyaluronidase (150 U) and 50 mg magnesium sulfate in 1 ml of 0.9% saline. which are divided equally in both inferotemporal and medial canthus areas.

Dexmedetomidine group: (25 patients).

They received 9 ml of the local anesthetic: 4.5 ml of 0.5% bupivacaine and 4.5 ml of 2% lidocaine mixed with hyaluronidase (150 U) and 15 mcg dexmedetomidine in 1 ml saline which are divided equally in both inferotemporal and medial canthus areas.

Assessments: The following were assessed: The success of the block:It was evaluated by scoring motor block(the mobility of the globe and the eyelid) and sensory block(by assessing corneal anesthesia using a small piece of cotton wool) at 2.5, 5, 7.5, and 10 min after injection. Evaluation of globe akinesia: It was done using a three-point scale (0-2)for each of the four

cardinal directions (upward,downward, nasal, and temporal) (Total score of 8).

Ocular movement in each direction was scored as: 0 if there is no directional movement. 1 if it is limited. 2 if it is normal.

A total score of 10 is obtained when we add the globe akinesia score (0–8) and the lid akinesia score (0–2).

Corneal anesthesia:The assesment of corneal anesthesia that was either sensitive or not was done by using a small piece of cotton wool at 2.5, 5, 7.5, and 10 min after injection.

Onset Time: (defined as the presence of corneal anesthesia together with an ocular movement score 1 or below in every direction and an eyelid akinesia score of 0) was recorded using a stopwatch.

Supplemental injection: If the adequate condition to begin surgery (corneal anesthesia together with an ocular movement score 1 or below in every direction and an eyelid akinesia score of 0). was not achieved 10 min after performing the block, a supplemental injection of 3 ml of 2% lidocaine was be administered either inferotemporally or medially on the basis of the anesthesiologist's assessment

Statistical Design: Statistical analyses were carried out using the computerized statistical package for the social sciences for windows, version 18 (SPSS Inc, Chicago, IL). All data are expressed as mean and standard deviation or number of patients (percentage) as appropriate. One-way analysis of variance (ANOVA) test was conducted to detect differences among the treatment groups with respect to parametric variables, followed by TUKEY'S Test for intergroup comparisons. However, categorical variables such as gender, sex, and ASA status or surgery type were analyzed using Chi-Squared test. Significance level was considered at $P < 0.05$ and insignificant at $P > 0.05$.

RESULTS

The current study was carried on 75 patients divided into Three equal groups: first group (control group), second group (dexmedetomidine group) and third group (magnesium sulphate group) All patients were scheduled for surgery.

Table (1): Comparison between groups according to globe akinesia.

Globe Akinesia	Group (DEX) (N=25)	Group (Mg) (N=25)	Control (N=25)	ANOVA	p-value
Globe Akinesia 2.5 Mean±SD Range	7.20±0.65 6-9	7.56±0.65 7-9	9.04±0.68 7-10	76.016	<0.001
Globe Akinesia 5 Mean±SD Range	4.68±0.48 4-5	5.04±0.45 4-6	5.68±0.95 5-8	20.578	<0.001
Globe Akinesia 7.5 Mean±SD Range	1.80±0.82 1-5	3.28±1.14 1-5	4.28±1.31 2-6	56.038	<0.001
Globe Akinesia 10 Mean±SD Range	0.56±0.04 0-5	0.80±0.07 0-5	2.16±0.27 0-5	7.863	<0.001

Globe akinesia:

Evaluation of the globe akinesia was done at 2.5, 5, 7.5 and 10 min. after injection as shown in table (1). The onset of motor block showed a statistically significant difference between the Three groups ($P < 0.05$).

At the 2.5 minute, the dexmedetomidine group showed rapid onset of motor block (7.20 ± 0.65) then magnesium sulphate group (7.56 ± 0.65) then lastly the control group (9.04 ± 0.68).

At the fifth minute, the dexmedetomidine group showed more rapid onset of motor block (4.68 ± 0.48) then magnesium sulphate group (5.04 ± 0.45) then lastly the control group (5.68 ± 0.95).

At the 7.5 minute, the dexmedetomidine group showed more rapid onset of motor block (1.80 ± 0.82) then magnesium sulphate group (3.28 ± 1.14) then lastly the control group (4.28 ± 1.31).

At the tenth minute, the dexmedetomidine group showed more rapid onset of motor block (0.56 ± 1.04) then magnesium sulphate group (0.80 ± 1.87) then lastly the control group (2.16 ± 2.27).

Table (2): Comparison between groups according to corneal anaesthesia

Corneal Anaesthesia	Group (DEX) (N=25)	Group (Mg) (N=25)	Control (N=25)	x2	p-value
Corneal Anaesthesia 2.5 No pain Pain	20 (80.0%) 5 (20.0%)	19 (76.0%) 6 (24.0%)	8 (32.0%) 17 (68.0%)	15.625	<0.001
Corneal Anaesthesia 5 No pain Pain	24 (96.0%) 1 (4.0%)	22 (88.0%) 3 (12.0%)	19 (76.0%) 6 (24.0%)	4.319	0.229
Corneal Anaesthesia 7.5 No pain	25 (100.0%)	25 (100.0%)	25 (100.0%)	0.000	1.000
Corneal Anaesthesia 10 No pain	25 (100.0%)	25 (100.0%)	25 (100.0%)	0.000	1.000

Corneal anaesthesia:

Evaluation of the corneal anaesthesia was done at 2.5, 5, 7.5 and 10 min after injection as shown in table (2). The onset of sensory block showed a statistically significant difference

between the Three groups ($P < 0.05$). At the 2.5 minute, the dexmedetomidine group showed more rapid onset of sensory block (20 patients) then magnesium sulphate group (19 patients) then lastly the control group (8 patients).

At the 5 minute, the dexmedetomidine group showed more rapid onset of sensory block (24 patients) then magnesium sulphate group (22 patients) then lastly the control group (19 patients).

At the 7.5 and 10 all patients had corneal anaesthesia and there was no difference between the three groups.

Table (3): Comparison between groups according to onset min and supplemental injection.

	Group (DEX) (N=25)	Group (Mg) (N=25)	Control (N=25)	F/x2#	p-value
Onset Min Mean±SD Range	7.42±2.27 5-13	8.14±2.17 5-13	10.38±2.74 7.5-14	16.530	<0.001
Supplemental INJ No need Need	24 (96.0%) 1 (4.0%)	21 (84.0%) 4 (16.0%)	14 (56.0%) 11 (44.0%)	22.024#	<0.001

Onset of block and supplemental injection:

As regard the onset of block, it showed statistical significant difference between the three groups ($P < 0.05$). The onset of block was rapid in the dexmedetomidine group (7.42 ± 2.27 min.), then the magnesium sulphate group (8.14 ± 2.17 min.) and the control group (10.38 ± 2.74 min.), as shown in table (3).

DISCUSSION

The current study compared the effect of adding NMDA receptor antagonist (magnesium sulphate) and a centrally acting α_2 -agonist (dexmedetomidine) to a local anesthetic mixture (bupivacaine/lidocaine).

In our study, the dexmedetomidine group showed a better akinesia compared to magnesium sulphate group and control groups.

The results of this study agree with those of *Sinha et al.*⁽²⁾ who carried study on 60 patients to examine the effect of adding 50 mg magnesium sulphate to a mixture of lidocaine 2% and bupivacaine 0.5% in peribulbar anesthesia for ophthalmic surgeries. They found that

adding magnesium sulphate to the anesthetic mixture accelerated onset of anesthesia and shortened the time for suitable conditions to start surgery without any side effects.

Also, our conclusion coincides with the findings of *Abd Elhamid*⁽⁸⁾ who reported that

administration of magnesium as a co factor to the local anesthetic in peribulbar anesthesia accelerated the onset of sensory and motor block without any side effects.

Abu Elyazed and Mostafa⁽⁹⁾ in their study on 90 patients Scheduled for cataract surgery under peribulbar anesthesia, compared between 50 mg of magnesium sulphate and 20mic fentanyl as additives to a mixture of lidocaine 2% and bupivacaine 0.5% plus 150 IU of hyaluronidase and they found that both fentanyl and magnesium prolonged the duration of globe akinesia, lid akinesia, and post operative analgesia. Magnesium could accelerate the onset of globe anesthesia, akinesia, and lid akinesia in comparison to the control group but still significantly slower than the fentanyl group.

On the other hand, *Hamawy and Bestarous*⁽¹⁰⁾ in their study on 75 patients scheduled for cataract surgery aged between 40 and 80 years, found that adding 50 mg magnesium sulphate to the local anesthetic mixture in peribulbar anesthesia had no beneficial effects on the onset of the block or akinesia score.

The work done under similar condition, supported the results of *Channabasappa et al.*⁽¹¹⁾ who examined two doses of dexmedetomidine 25mic and 50mic as adjuvant to a mixture of 3 ml lidocaine 2% and 3 ml bupivacaine 0.5% in peribulbar anesthesia for cataract surgery on 90 patients and they found that administration of dexmedetomidine accelerated the onset of the peribulbar anesthesia, prolonged its duration, and prolonged postoperative analgesia. They found that the dose of 50mg dexmedetomidine produce sedation which make the patient more cooperative.

The results of the present study are in agreement with those of *Hafez et al.*⁽¹²⁾ who evaluated the effect of three doses of dexmedetomidine 15mg, 20mg, 25mg when added to a mixture of lidocaine 2%, bupivacaine 0.5%, and 120 IU of hyaluronidase for peribulbar anesthesia in vitreoretinal surgeries on 160 patients and they found that dexmedetomidine accelerated onset of sensory and motor block and increased its duration and the analgesia time. They found that the best dose was 25mic dexmedetomidine.

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