ORIGINAL ARTICLE

Evaluation of Analgesic and Anesthetic Efficacy of Magnesium Sulphate in Regional Blocks: Quasi-Experimental Study

Khalid Ameer, Moazzam Ali, Muhammad Ali Abbas, Sanum Kashif*, Muhammad Huzaifa Sharif

ABSTRACT

Objective: To evaluate the anesthetic and analgesic efficacy of magnesium sulphate as an adjunct to local anesthesia in Regional Blocks.

Study Design: A quasi-experimental study.

Place and Duration of Study: This study was conducted at the main operating theatre (OT), Combined Military Hospital (CMH), Lahore, Pakistan from 3rd November 2022 to 5th September 2023.

Methods: A total of 70 patients (35 in each group), aged 18-45 years of either gender, American Society of Anesthesiology Status I or II, undergoing ophthalmological surgeries under regional blocks were enrolled in the study. Patients were divided into two groups: Group A - Magnesium Sulphate (N = 35) and Group B - Placebo (N = 35). The peribulbar block was performed with 0.5% bupivacaine and 2 % lignocaine without adrenaline in a 10 ml syringe in equivalent proportions. In this compound of local anaesthetic, 1ml of 0.9% normal saline was added to Group B members as a placebo treatment, while in Group A, 50 mg magnesium sulphate was added. Lid and globe akinesia were evaluated at 1, 5, and 15 minutes, and the duration of lid and globe akinesia was recorded. The analgesia requirement at the first and third hours was also recorded as per the visual analogue score.

Results: Mean age of participants was 39.1 ± 5.2 years. Duration of Lid Akinesia in A and B was 115 ±7.9 minutes and 135 ± 5.9 minutes, respectively; whereas, duration of Globe Akinesia in A and B was 180.5±7.9 minutes and 225 ± 6.5 minutes, respectively. Visual Analogue Score at 1st hour in A was 1.4 ± 0.50 and B 2.5 ± 0.50 (*P*<.001). At the 3rd hour, results were 3.4 ± 1.1 and 4.5 ± 1.1 in groups A and B, respectively (*P*<.001). Onset of Lid Akinesia at 1 minute in A was among 18 (51.4%) patients, whereas in B, in 3 (8.6%) (*P*<.001).

Conclusion: Magnesium sulphate as an adjunct to local anesthetic in regional blocks can promote earlier inception and prolonged duration with pronounced analgesic prospects.

Keywords: *Analgesia, Bupivacaine, Lignocaine, Magnesium Sulphate, Nerve Block, Visual Analogue Scale.*

How to cite this: *Ameer K, Ali M, Abbas MA, Kashif S, Sharif MH. Evaluation of Analgesic and Anesthetic Efficacy of Magnesium Sulphate in Regional Blocks: Quasi-Experimental Study. Life and Science. 2025; 6(2): 368-374. doi: http://doi.org/10.37185/LnS.1.1.557*

Introduction

Local anaesthesia is a mainstay for ophthalmological procedures and surgeries, which provides several advantages for geriatric patients. Peri-bulbar eye block is expedient and commodious technique with minimal financial implications.[1] It is practical in the provision of adequate and safe anesthesia without exposing the patient to the repercussions of general anaesthesia. It sufficiently provides lid akinesia and globe akinesia, therefore adding to the surgeon's contentment and ease of procedure performance.[2,3] Also appropriate for postoperative analgesia, therefore, sparing Opioids and Non-Steroidal anti-inflammatory drugs (NSAIDs), consumption of which leads to gastrointestinal and renal manifestations.[4] Constant endeavors urged for augmentation of analgesic and anesthetic potential of local anesthetics to achieve earlier onset and prolonged duration, thus to discover a perfect nociception

Department of Anesthesia
Combined Military Hospital (CMH) Lahore, Pakistan
Correspondence:
Dr. Sanum Kashif
Department of Anesthesia
Combined Military Hospital (CMH) Lahore, Pakistan
E-mail: sanumdr@gmail.com

Received: Dec 19, 2023; 1st Revision Received: Jun 27, 2024
2nd Revision Received: Jan 17, 2025; Accepted: Feb 05, 2025

inhibition agent.[5,6]

For decades, globally, the advantages of Magnesium Sulphate have been recognized as an anticonvulsant in eclampsia patients and medicate toxaemia of preeclampsia, but a multitude of beneficial aspects of the drug have yet to unfold.[7] Magnesium constitute to be an essential mineral of the human body as magnesium ions are responsible for vital biochemical reactions. Its deficiency can lead to significant clinical manifestations such as tiredness, paresthesias, seizures, abnormal heart rhythms, to name a few.[8]

Magnesium, being on the fourth slot among essential body enzymes, has recently seen its utility in pharmacology being discovered in numerous profiles. It activates over three hundred enzymatic reactions in the body, of which energy metabolism is notable to mention. Its anti-nociceptive property is attributable to calcium antagonism, involved in calcium channel regulation in a voltage-dependent manner and cell influx; moreover, it provides noncompetitive antagonism to N-methyl-D-aspartate (NMDA) receptors.[9,10] The main objective of the study is to evaluate the anesthetic and analgesic action of Magnesium sulphate in regional block

Methods

The study was conducted at the main Operation Theatre (OT), Combined Military Hospital (CMH), Lahore, Pakistan, from 3rd November 2022 to 5th September 2023 after receiving written informed consent and Institutional Review Board approval from the institute vide letter no: ERC/482/23, dated: 24th October 2021. A total of 70 American Society of Anesthesiology (ASA) I or II patients, 18-45 years, who were undergoing surgery under general anesthesia with endotracheal intubation were included. The sample size of 70 subjects (35 in each group) was calculated by open epi sample size calculator using a two-sided level of significance (1-alpha) of 95%, power of study (% chance of detecting) 80%, hypothetical proportion of controls with exposure 40 and hypothetical proportion of cases with exposure 10.7 and least extreme odds ratio to be detected 0.18, with an equal ratio of cases to controls. A consecutive non-probability technique was used for sampling.[11]

As per the study protocol, all patients were interviewed, briefed, and counselled about the procedure, and informed written consent was obtained. Before reporting to the operating theatre, a detailed pre-anaesthesia assessment was carried out in all patients with necessary laboratory evaluation parameters to adhere to our inclusion and exclusion criteria, besides, to ensure patient safety, which is of utmost concern in anesthetic management.

Non-consenting patients, pregnant and lactating females, patients with BMI > 30, patients with difficult airways, patients unwilling to undergo surgery under local anaesthesia, patients allergic to study drugs, patients with known ischemic heart disease or any focal neurological deficit, and patients with coagulation disorders were excluded.

Patients (N = 70) were isolated into two groups. Magnesium Sulphate Group designated as A - (N = 35) and Normal Saline (Placebo) as B – (N = 35). As pre-operative preparation, consummation of fundamental documentation and an overnight fast/Nil per oral was ensured. Patients were prepared according to standard operating guidelines of general anaesthesia due to the anticipation of proceeding with general anaesthesia in case of block failure or to augment block and alleviate patient anxiety with conscious sedation in case of apprehensive patients to ensure patient comfort, cooperation, and satisfaction. Furthermore, to facilitate the surgeon's performance of surgery with utmost deliberation and ease. On the day of surgery, patients are brought to the operating theatre and before initiating anaesthesia, standard monitoring such as blood pressure (non-invasive method), pulse oximeter (SpO2), end-tidal carbon dioxide (ETCO2), and electrocardiography electrodes are attached.

Throughout surgery, blood pressure was recorded by a non-invasive technique every 05 minutes, a pulse oximeter, and Electrocardiography electrodes were attached. SpO_2 and Heart rate, 20% below baseline were considered significant. 18G IV cannula passed under aseptic conditions. All the patients were premedicated with intravenous injections of Dexamethasone 0.08 mg/kg, Metoclopramide 0.1 mg/kg, and Midazolam 1 mg for the provision of conscious sedation and the prevention of nausea

and vomiting. The peribulbar block was performed with 0.5% bupivacaine and 2 % lignocaine without adrenaline in a 10 ml syringe in equivalent proportions. In this compound of local anaesthetic, 1ml of 0.9% normal saline was added to Group B members as a placebo treatment, while in Group A, 50 mg magnesium sulphate was added. Landmarks were superior to the infraorbital rim at the junction of the middle two-thirds and outer one-third (infratemporal quadrant). The patient was then instructed to look down inferior and medial to the supraorbital notch. Then the patient was instructed to look down inferior and medial to the supraorbital notch. Gentle pressure is applied after infiltration. Lid and globe akinesia were evaluated using the following score. (Table 1). Even though the block was surveyed each moment till 15 minutes (the complete block was accomplished by 15 minutes), results were recorded and analyzed at 01 minute, 05 minutes, and 15 minutes. Duration of lid and globe akinesia was recorded.

Postoperatively, pain was surveyed with a Visual Analogue Scale (VAS). VAS is a psychometric response scale for the estimation of pain. In this scale, subjects respond to their degree of pain by indicating on a continuous line between two endpoints. (Figure 1).

Table 1: Scoring System

Akinesia of the extraocular muscles, including the levator muscle
0 = 0-1 mm movement in 1 or 2 main directions, or 0 to 4 mm movement in the levator muscle, or 0 to 4 mm movement in the levator muscle
1 =1 mm movement in more than two main directions, or 2 mm movement in any main direction, or more than 4 mm movement in the levator muscle
2 = > than 2 mm movement in any main direction or 2 mm movement in 2 or more main directions
Akinesia of the orbicularis muscle
0= Complete akinesia
1= Partial movement in either or both eyelid margins
2= Normal movement in either or both eyelid margins

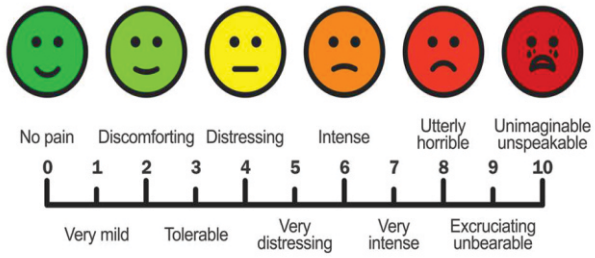

Fig.1: Visual Analogue scale

Patients were kept in the post-anesthesia recovery unit for 01 hour and later moved to the post-operation ward, guaranteeing stable vital signs and meeting recovery scores, well within the premises of the operating theatre. Variables evaluated age, gender, American Society of Anesthesiologists status (ASA), globe akinesia duration, lid akinesia duration, analgesia prerequisite [first and third hour] and visual analogue score [first and third hour], lid akinesia onset [1,5,10 minutes] and globe akinesia at [1,5,10 minutes].

Data was entered and analyzed using Statistical Package for Social Sciences (SPSS) version 22.0. Descriptive statistics of continuous variables, including age, globe akinesia duration, lid akinesia duration, and visual analogue scores, were expressed as mean and standard deviation, while categorical variables, including gender, analgesic consumption, and American Society of Anesthesiologists status, were expressed as frequency and percentages. The mean value of the primary outcome of the study, i.e., post-operative pain, measured on a continuous scale, was compared between two study groups using Student's t-test. Other categorical variables were compared using the chi-square test. The *P*-values ≤0.05 were considered to be statistically significant.

Results

A total of 70 patients were enrolled in the study, which included an age range of 18 - 45 years; therefore, the mean age of the sample was 39.1±5.2

years. Participants included 28 (40%) females and 42 (60%) males [*P*=0.23]. ASA status distribution was [I 18 (25.7%), II 52 (74.3%), *P*-value.39]. Duration of Lid Akinesia in Groups A and B was 115 ±7.9 minutes and 135±5.9 minutes, respectively. At the same time, the duration of Globe Akinesia in Group A and B was 180.5±7.9 minutes and 225 ± 6.5 minutes, respectively.

VAS in the 1st hour in Group A was 1.4 ± 0.50 and Group B 2.5 ± 0.50 (*P*<.001). At the 3rd hour, results were 3.4 ± 1.1 and 4.5 ± 1.1 in group A and B, respectively (P<.001) (Table 3). Onset of Lid Akinesia at 1 minute was observed in 18 (51.4%) patients in Group A, compared to 3 (8.6%) in Group B (*P*<.001). Globe Akinesia at 1 minute was observed in 5 (14.3%) participants in Group A, whereas in Group B, none of the participants exhibited at the 1st minute (*P*.054) (Table 2). None of the patients in Group A requested analgesia at 35 (100%) 1st hour, whereas in Group B, 22 (62.9%) patients complained about pain, and 13 (37.1%) did not (*P*<.001). However, after 03 hours of surgery, 35 (100%) in the normal saline group demanded pain relief; on the other hand, 25 (71.4%) participants had analgesic requirements, and 10 (28.6%) patients were still comfortable (*P*<.001). (Table 4).

Table 2: Summary of Globe and Lid Akinesia

Onset		Frequency		*Chi-Square* value	*P*-value
		Group A N = 35 (%)	Group B N = 35 (%)		
Lid Akinesia	1 minute	18 (51.4%)	3 (8.6%)	13.720	<0.001
	5 minutes	100%	97.1%	1.014	0.314
	10 minutes	100%	100%	-	-
Globe Akinesia	1 minute	5 (14.3%)	0 (0%)	4.242	0.039
	5 minutes	32 (91.4%)	28 (80%)	1.867	0.172
	10 minutes	100%	100%	-	--

Table 3 : Summary of Analgesic Requirement

Analgesia requirement	Frequency				*Chi-Square value*	*P*-value
	Group A (N = 35)		Group B (N = 35)			
	Yes	No	Yes	No		
1st Hour	0 (0%)	35 (100%)	22 (62.9%)	13 (37.1%)	32.082	<0.001
3rd Hour	25 (71.4%)	10 (28.6%)	35 (100%)	0 (0%)	11.667	0.001

Table 4: Visual Analogue Score (VAS)

Visual Analogue Score	Group A (N = 35) Mean ± SD	Group B (N = 35) Mean ± SD	*t-test* value	*P*-value
1st Hour	1.4 ± 0.50	2.5 ± 0.50	-9.20	<.001
3rd Hour	3.4 ± 1.1	4.5 ± 1.1	-4.18	<.001

Discussion

Magnesium has attracted enthusiasm due to its multimodal potential. A number of studies have been conducted to establish its utility.[12] The peribulbar block has been utilized broadly for ophthalmic surgery as it is more secure than a retrobulbar block. There is a delayed onset of akinesia with peribulbar block in contrast with retrobulbar block, which may prompt a deferral to begin the surgical procedure. Paucity of analgesia also hinders the peribulbar block when compared with the retrobulbar block. Different adjuvants, such as clonidine, fentanyl, corticosteroids, and dexmedetomidine, have been utilized to accelerate the onset of akinesia in peribulbar block. Unfortunately, these adjuvants are accompanied by bradycardia, sedation, dryness of mouth.[13]

We opted for Magnesium as our preliminary study drug since its use as a neuraxial block adjuvant has already been recognized. Furthermore, its ease of availability and cost made it an ideal ancillary and hypothetical drug. Results of our study determined that expansion of local anesthetic with magnesium improves the length of the lid and globe akinesia,

along with early initiation (P<0.001). Moreover, there was a diminished early postoperative analgesic demand (P < 0.001).[14]

Sinha et al. separated the practicality of magnesium as an additional substance to local anaesthetic in the peribulbar block.[15] They recorded absolute akinesia, findings matched with our outcomes. Both groups were administered 4.5 ml of 2% lidocaine, 4.5 ml of 0.5% bupivacaine with 150 IU hyaluronidase. Group NS received normal saline 1 ml in the peribulbar block, and Group MS received magnesium sulphate 50 mg in 1 ml of normal saline. In the Group NS at 3, 5, 10, and 15 minutes after the block, total akinesia was found in 0, 2, 11, and 28 patients, respectively. In the Group MS, at 3, 5, 10, and 15 minutes after the square, total akinesia was found in 13, 23, 27, and 28 patients separately. Patients who received magnesium sulfate demonstrated a significantly faster onset of lid and globe akinesia than the benchmark group until 10 min (P < 0.000).[15]

Abd et al. evaluated dexmedetomidine (50µg) with magnesium sulphate (50mg) in a peribulbar block.[16] Both agents increase the onset of akinesia with stable hemodynamics. However, dexmedetomidine gives the advantage of reduced intraocular pressure, but has the disadvantage of cost. The interval for the first pain-relieving demand was 245 ± 25.0 min for the D group and 239 ± 31.5 for the M group. The beginning of global akinesia was progressively faster for group D (P = 0.523).[16]

Mogahed et al. evaluated two doses of magnesium sulphate (50 mg and 100mg) as an adjunct to 0.5% ropivacaine in peribulbar block.[17] Group I (Control group): patients got peribulbar block utilizing a blend of 6 ml of 0.5% ropivacaine, 1 ml (150 IU) hyaluronidase and 1 ml of normal saline, Group II (Mg 50): patients got a peribulbar block with 6 ml of 0.5% ropivacaine, 1 ml (150 IU) hyaluronidase and 50 mg of magnesium sulphate in 1 ml saline and Group III (Mg 100): patients got a peribulbar block with 6 ml of 0.5% ropivacaine, 1 ml (150 IU) hyaluronidase and 1 ml of 100 mg magnesium sulphate. Absence of pain was evaluated by utilizing a visual analogue score (VAS) at the completion of the surgical procedure, 1 h, 2 h, 4 h, and 6 h. Patients who received magnesium sulfate demonstrated essentially rapid onset of lid and globe akinesia(P<0.0001), similar to our examination results (P<0.001). Analgesic requirement was also reduced (P<0.0001).[17]

Shoukry et al. compared magnesium with dexmedetomidine in percutaneous peribulbar block in vitreoretinal surgeries; the results were proportionate in terms of the globe and lid akinesia.[18] The advent of globe akinesia and anesthesia were shorter in the magnesium group in correlation with the control and dexmedetomidine group (P<0.001).[18]

Mohamed AA et al. differentiated magnesium sulfate and clonidine as an adjuvant to local anesthetic in peribulbar block.[19] The onset of eyelid akinesia was earlier in group M as opposed to the other two groups, while the length of akinesia was significant in group C (196.2±5.8) (P<0.05). The onset of globe akinesia is generally rapid in group M as compared to the other two groups (P< 0.05), while the length of globe akinesia is profoundly critical in group C (293.7±5.7) (P< 0.05). Regarding analgesic potential, both group M and C were conspicuous than group O (placebo) with no notable distinction between the M & C groups (P<0.05). According to their results, magnesium sulphate had an earlier start of globe akinesia when compared with clonidine.[19,20]

Magnesium sulphate as an adjunct to local anesthetic in the regional block (Peribulbar Block) can produce earlier onset and longer duration of lid and globe akinesia with enormous analgesic potential and with no noteworthy adverse effects. Magnesium sulphate fusion with local anesthetic outfits, suitable operating conditions, with patient and surgeon satisfaction, additionally will save time too in a busy operating theatre schedule.

Trials with a larger sample size to be carried out to utilize analgesic and potentiation of anaesthetic potential. Its ease of availability and cost can make it an ideal drug, especially for third-world countries with limited budgets for the health sector and paucity of resources.

Conclusion

Magnesium sulphate as an adjunct to local anesthetic in regional blocks can promote earlier inception and prolonged duration with pronounced analgesic prospects.

Acknowledgment: None

Conflict of Interest: The authors declare no conflict

of interest

Grant Support and Financial Disclosure: None

REFERENCES

1. Shetty KP, Satish SV, Kilaru KR, Sardar P, Luke AM. Comparison of anesthetic efficacy between lidocaine with and without magnesium sulfate USP 50% for inferior alveolar nerve blocks in patients with symptomatic irreversible pulpitis. Journal of endodontics. 2015; 41: 431-3. doi: 10.1016/j.joen.2015.01.003
2. Hamawy T, Bestarous J. Rocuronium versus magnesium as an adjuvant to local anesthetics in peribulbar block. Ain-Shams Journal of Anesthesiology. 2013; 6: 317-21. doi: 10.7123/01.ASJA.0000433031.32476.a3
3. Mohamed AZ, Genidy MM. Magnesium sulphate versus dexmedetomidine as an adjuvant to local anesthetic mixture in peribulbar anesthesia. Egyptian Journal of Anaesthesia. 2017; 33: 375-80. doi: 10.1016/j.egja.2017.07.001
4. M Soliman AA. Assessment of value of epidural magnesium sulfate in postoperative analgesia after lower limb vascular surgery. Journal of Medicine in Scientific Research. 2018; 1: 101-5. doi: 10.4103/JMISR.JMISR_29_18
5. Kassem OA, ELgarhy AM, Salim MG. Magnesium sulphate versus Dexmedetomidine as adjuvants for local anasthetics in peribulbar block for eye surgeries: Clinical comparative study. The Egyptian Journal of Hospital Medicine. 2018; 72: 4308-12. doi: 10.21608/ejhm.2018.9244
6. Mousavi SA, Sadaghiani L, Shahnaseri S, Zandian A, Farnell DJ, Vianna ME. Effect of magnesium sulphate added to lidocaine on inferior alveolar nerve block success in patients with symptoms of irreversible pulpitis: a prospective, randomized clinical trial. International Endodontic Journal. 2020; 53: 145-53. doi: 10.1111/iej.13186
7. Yassin HM, Moneim AT, Bayoumy AS, Bayoumy HM, Taher SG. The influence of two different doses of magnesium sulfate on intraocular pressure variations after injection of succinylcholine and endotracheal intubation: A prospective, randomized, parallel three-arm, double-blind, placebo-controlled clinical trial. Anesthesia Essays and Researches. 2017; 11: 969-75. doi: 10.4103/aer.AER_35_17
8. Ibrahim DA, Salah D. Dexmedetomidine was better at lowering intraocular pressure than magnesium when combined with local anesthetics in peribulbar blocks for posterior segment eye surgery. The Open Anesthesia Journal. 2018; 12: 12-42. doi: 10.2174/2589645801812010042
9. Farouk S. Pre-incisional epidural magnesium provides pre-emptive and preventive analgesia in patients undergoing abdominal hysterectomy. British journal of anaesthesia. 2008; 101: 694-9. doi: 10.1093/bja/aen274
10. Gunduz A, Bilir A, Gulec S. Magnesium added to prilocaine prolongs the duration of axillary plexus block. Regional Anesthesia & Pain Medicine. 2006; 31: 233-6. doi: 10.1016/j.rapm.2006.03.001
11. Elmorsy E, Parrey MU. Posterior segment eye diseases: prevalence, pattern, and attribution to visual impairment among adult saudi population. The Annals of Clinical and Analytical Medicine. 2019; 10: 505-9. doi: 10.4328/ACAM.6089
12. Sarvela J, Nikki P, Paloheimo M. Orbicular muscle akinesia in regional ophthalmic anaesthesia with pH-adjusted bupivacaine: effects of hyaluronidase and epinephrine. Canadian journal of anaesthesia. 1993; 40: 1028-33. doi: 10.1007/BF03009472
13. Bourdel N, Alves J, Pickering G, Ramilo I, Roman H, Canis M. Systematic review of endometriosis pain assessment: how to choose a scale? Human reproduction update. 2015; 21: 136-52. doi: 10.1093/humupd/dmu046
14. Ghaderi F, Banakar S, Rostami S. Effect of pre-cooling injection site on pain perception in pediatric dentistry:"A randomized clinical trial". Dental research journal. 2013; 10: 790-4.
15. Sinha R, Sharma A, Ray BR, Chandiran R, Chandralekha C. Effect of addition of magnesium to local anesthetics for peribulbar block: A prospective randomized double-blind study. Saudi journal of anaesthesia. 2016; 10: 64-7. doi: 10.4103/1658-354X.169478.
16. Abd Elmoniem MF, Kamel RM. Peribulbar block using dexmedetomdine versus magnesium sulphate as additives to local anesthetics for cataract surgery. The Egyptian Journal of Hospital Medicine. 2019; 75: 2679-83. doi: 10.21608/ejhm.2019.31586
17. Mogahed MM, Anwar AG, Abo-elazm WN. The effect of adding two different doses of magnesium sulphate as adjuvant to ropivacaine in peribulbar block for cataract surgery. Journal of Anesthesia & Clinical Research. 2017; 8: 725-32. doi: 10.4172/2155-6148.1000725
18. Shoukry A, Abd el Kawy AS. Efficacy and safety of magnesium versus dexmedetomidine as additives to local anesthetic mixture using single injection percutaneous peribulbar anesthesia in vitreoretinal surgeries. The Open Anesthesia Journal. 2018; 12: 12-94. doi: 10.2174/2589645801812010094
19. Abd El-Hamid AM. Evaluation of the effect of magnesium sulphate vs. clonidine as adjunct to local anesthetic during peribulbar block. Ain-Shams Journal of Anesthesiology. 2011; 4: 21-6.
20. Abdalla Mohamed A, Safan TF. Fentanyl versus midazolam as additive to local anesthetic mixture for peribulbar block during posterior segment surgery in adult patients a prospective randomized double-blind study. Ain-Shams Journal of Anesthesiology. 2019; 11: 1-8. doi: 10.1186/s42077-019-0036-8

Author Contributions

KA: Writing the original draft, proofreading, and approval for final submission
MA: Conception and design of the work
MAA: Manuscript writing for methodology design and investigation
SK: Data acquisition, curation, and statistical analysis
MHS: Revising, editing, and supervising for intellectual content