To Evaluate the Effectiveness of Magnesium Sulphate as an Agent to induce Hypotensive Anaesthesia in Lumbar Spine Surgery. A Prospective Randomized, Placebo-Control Study

Dhanajay Kumar[1], K.K. Arora[2], Parul Jain[3]

ABSTRACT

Introduction: This randomized placebo controlled study was designed to evaluate the effectiveness of magnesium sulphate as an agent to induce hypotensive anaesthesia in lumbar spine surgery.

Material and Methods: The study included 100 patients of both sexes who were equally distributed in two groups, the Group Mg(Magnesium sulphate group) and Group C (control group). The Magnesium group received magnesium sulphate 40mg/kg administered as a slow IV bolus over a period of 10 minutes before induction and 15mg/kg/hr by continuous IV infusion during surgery. The same volume of isotonic saline was administered to the control group. Surgical time, heart rate and mean arterial blood pressure was measured.

Results: In the magnesium group there was reduction in surgical time (103.54 mins vs 117.34 mins), although the anaesthestic time was 9 minutes longer in the Magnesium group denoting a longer emergence time. The mean arterial pressure and heart rate were significantly reduced in Magnesium group($p<0.005$). Postoperative shivering was also less in Magnesium group.

Conclusion: Magnesium infusion resulted in a steady and smooth reduction in mean blood pressure and reduced heart rate, with no episodes of severe hypotension. Furthermore magnesium causes reduction in duration of surgical time and postoperative shivering.

Keywords: Magnesium Sulphate, Hypotensive Anaesthesia, Lumbar Spine, Heart Rate, Mean Arterial Blood Pressure, Shivering, Emergence Time.

INTRODUCTION

Controlled hypotension is performed in order to reduce blood loss and the need for blood transfusion during the surgery and to improve visibility of the surgical field. Spine surgery is mainly performed for the treatment of back pain, disc prolapse and other spine deformities. General anaesthesia is usually preferred in spine surgeries.

The ideal agent used for controlled hypotension must have certain characterstics such as ease of administration, a short onset time, rapid elimination without toxic metabolite, an effect that disappear quickly when administration is discontinued, negligible effects on vital organs and predictable and dose dependent effect

It has been reported that Magnesium sulphate is a good agent for controlled hypotension and has a high therapeutic index. Ever since the study of Magnesium sulphate in clinical anaesthesia beginning in 1996, Magnesium has drawn attention in the field of anaesthesia and pain medicine.

Magnesium is the fourth most common cation in the body and has a key role in hundreds of physiologic processes.[1,2] Magnesium stabilizes the cell membrane and intracytoplasmic organelles by mediating the activation of sodium potassium ATPase and calcium ATPase enzymes, which play a role in transmembrane ion exchange during the depolarization and repolarization phases.[3]

Magnesium acts as vasodialator by increasing the synthesis of prostacyclin as well as by inhibiting the angiotensin converting enzyme activity.[5] IV Magnesium sulphate has also led to a significant reduction in fentanyl, propofol and muscle relaxant consumption during intraoperative period.[8,9]

Parenteral Magnesium sulphate has been used for many years as an anti-arrhythmic agent and for prophylaxis against seizure in preeclampsia

In our study primary objective was to assess the effect of perioperatively administered IV magnesium sulphate as an agent of hypotensive anaesthesia in lumbar spine surgery and secondary objective was to assess the effect of Magnesium sulfate on postoperative shivering and the effect of Magnesium sulfate on postoperative sedation.

MATERIAL AND METHODS

The study was undertaken in the department of Anaesthesiology, M.Y. Hospital, M.G.M. Medical College Indore. The study included 100 patients of both sexes who were equally distributed in two groups, the Group Mg (Magnesium sulphate group) and Group C (control group). After approval of the institutional ethics committee, written informed consent were obtained from the patient before taking into operating room. In operation theatre after establishing an intravenous route, ringer lactate solution started. Patients premedicated with inj. Glycopyrollate 0.01mg /kg and inj.

[1]Post Graduate Student, Department of Anaesthesiology, MGM Medical College, Indore [2]Professor and HOD, Department of Anaesthesiology, MGM Medical College, Indore, [3]Associate Professor, Department of Anaesthesiology, MGM Medical College, Indore, India

Corresponding author: Dr Parul Jain, T-402 Shalimar Palms, Behind Agrawal Public School, Pipaliyahana Indore, MP pin 452016, India

How to cite this article: Dhanajay Kumar, K.K. Arora, Parul Jain. To evaluate the effectiveness of magnesium sulphate as an agent to induce hypotensive anaesthesia in lumbar spine surgery. a prospective randomized, placebo-control study. International Journal of Contemporary Medical Research 2019;6(4):D4-D7.

DOI: http://dx.doi.org/10.21276/ijcmr.2019.6.4.29

Midazolam 0.03 mg/kg. Standard monitoring including electrocardiography (ECG), noninvasive blood pressure (NIBP), oxygen saturation (SpO2) was continuously performed. The Magnesium group received magnesium sulphate 40mg/kg administered as a slow IV bolus over a period of 10 minutes before induction and 15mg/kg/hr by continuous IV infusion during surgery. The same volume of isotonic saline was administered to the control group. After preoxygenation of 5 minutes anaesthesia induced with fentanyl 2micrograms/kg and propofol 2mg/kg.Muscle relaxant vecuronium in dose of 0.1mg/kg was given and orotracheal intubation was performed after ventilating the patient for 2 mins and 45 seconds and 57 further set of recordings were done. Anaesthesia was maintained with 50% oxygen and 50% nitrous oxide, isoflurane and intermittent IV bolus of fentanyl 0.5mics/kg. During the intraoperative period both groups received IV fluids (R.L) @5ml/kg/hr Muscle relaxation was achieved with an infusion of vecuronium @1mics/kg/min Mean arterial pressure and heart rate were measured at following time before induction, before intubation, after intubation, at 5 min, 15min, 30min, 45min, 60min and 1 hourly till the end of the surgery. Combination of neostigmine 0.05mg/kg and In J. Glycopyrollate 0.01mg/kg was administered to reverse the neuromuscular block. Extubation was performed smoothly. Each patient was observed continuously after termination of anesthesia and times of events were recorded by the anaesthetist. All patients received standard post-operative care.

After transfer to the recovery room, patients were assessed neurologically for any sign of hypermagnesaemia (impaired breathing, inadequate tidal volume and decreased or absent deep tendon reflexes). Any adverse events or side effects were recorded during the perioperative and postoperative period. In addition, episodes of post operative shivering were monitored. Adequate measures were taken to control the post operative shivering. Also consciousness score was evaluated by using modified Aldrete score 0 – Not responding, 1 – Arousable with minimal stimulation, 2 – Fully awake.

Inclusion Criteria

1. Age group 18yrs -55yrs under going lumber spine surgery.
2. A.S.A Grade I and II

Exclusion criteria

1. A.S.A Grade III, IV and V
2. Patient refusal
3. Patient with cardiac dysarrhythmias, Liver and renal dysfunction
4. Patient with sinus bradycardia and on alpha blocker and calcium channel blockers.
5. Allergy to the drug under study.

STATSITICAL ANALYSIS

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences, IBM, 20.0 version.). Data was analysed for normality of distribution using Shapiro-Wilk test, p value < 0.05 indicated that data was not normally distributed, thus non parametric test of significance were applied. The comparison between the groups was done using Man whitney U test. p value < 0.05 was considered statistically significant.

RESULTS

In Magnesium group, the duration of surgery was 103.54 minutes and in control group it was 117.34 minutes (p value 0.000) (table-1). This was statistically significant. In the magnesium group, the duration of Anaesthesia was 129.40 minutes and in control group it was 134.90 minutes. The anaesthestic time was 9 minutes longer in the Magnesium group denoting a longer emergence time in Magnesium group than control group. The preanaesthetic blood pressure (p value = 0.260) and heart rate (p value = 0.738) was not significantly different between the groups but at 5,15, 30 and 60 mins and at the end of surgery they were significantly lower in Magnesium group than in control group (p value

	Mg Group (n=50)		Control Group (n=50)		P value
	Mean	Standard deviation	Mean	Standard deviation	
Duration of surgery (in minutes)	103.54	6.181	117.34	3.583	0.000*
Duration of anesthesia (in minutes)	129.40	5.771	134.90	3.671	0.000*
IV intake of fluid (ml)	1275.00	75.084	1315.00	71.606	0.001*

Table-1: Description of mean duration of surgery, duration of anaesthesia and amount of IV fluid intake of the patients.

		Mg Group (n=50)		Control Group (n=50)		P value
		Mean	Standard deviation	Mean	Standard deviation	
Blood pressure in mm Hg	Preanaesthetic	88.18	5.612	89.42	5.280	0.260
	Preoperative	82.64	4.452	86.30	4.747	0.000*
	5 minutes after incision	78.02	3.126	82.44	3.939	0.000*
	15 minutes after incision	74.34	2.528	78.40	2.835	0.000*
	30 minutes after incision	70.96	2.166	76.10	2.533	0.000*
	45 minutes after incision	68.1600	1.972	74.04	2.203	0.000*
	60 minutes after incision	65.38	1.724	72.98	2.394	0.000*
	At the end of surgery	74.22	2.131	78.14	1.873	0.000*

Table-2: Intra operative comparison of mean blood pressure (MBP) of patients in Mg group and Control group at different points of time.

		Mg Group (n=50)		Control Group (n=50)		P value
		Mean	Standard deviation	Mean	Standard deviation	
Heart rate	Preanaesthetic	87.74	10.483	86.84	7.533	0.738
	Preoperative	81.56	9.198	83.28	6.509	0.293
	5 minutes after incision	75.96	8.020	79.38	6.127	0.035*
	15 minutes after incision	71.48	7.223	77.14	5.252	0.000*
	30 minutes after incision	67.76	7.135	74.96	5.360	0.000*
	45 minutes after incision	64.68	6.929	73.22	5.112	0.000*
	60 minutes after incision	61.48	6.446	71.74	5.049	0.000*
	At the end of surgery	71.80	5.082	77.88	3.335	0.000*

Table-3: Intra operative comparison of Mean Heart Rate of patients in Mg group and Control group at different points of time

		Mg Group (n=50)	Control Group (n=50)
Shivering	Yes	5	18
	No	45	32
P value – 0.002			

Table-4: Frequency distribution of patients in Mg group and Control group based on the presence and absence of shivering.

< 0.05) (table-2). In Magnesium group only 5 patients had shivering but in control group 18 Patients had shivering. So statistically there was significant difference between both the groups in context of shivering (p value0.002). On the basis of consciousness score both the groups are comparable and no significant difference is seen between the groups.(P Value - 0.066) (table-3,4).

DISCUSSION

In our study, the primary objective was to assess the effect of perioperatively administered IV Magnesium sulphate as an agent of hypotensive anaesthesia in lumbar spine surgery. Results in the study showed that patients in the Magnesium group had reduced mean arterial blood pressure and heart rate in comparision to control group with no episodes of severe hypotension. The possible mechanisms for reduction of the mean blood pressure and heart rate include antagonism of NMDA receptors in the CNS by Magnesium[6] and reduction of catecholamine release by sympathetic stimulation thus decreasing peripheral nociceptor sensitization and the stress response to surgery.

No patient had rebound hypertension when the Magnesium sulphate infusion was stopped which can occur with other hypotensive anaesthesia techniques using arterial vasodilation. In May 2006 N. M. Elsharnouby and M. M. Elsharnouby, in their study on 60 patients undergoing functional endoscopic sinus surgery, concluded that where infusion of Magnesium sulphate led to reduction in arterial pressure, heart rate, duration of surgery.[11,12] In our study the surgical time was significantly reduced in Magnesium group as compared to control group (103.54 mins vs 117.34 mins). This may be attributed to the fact that in patients with Magnesium group operative field was better with reduced blood loss.

The anaesthestic time was 9 minutes longer in the Magnesium group denoting a longer emergence time, this may be attributed to the fact that Magnesium suppresses the release of acetylcholine and blocks transmission at the neuromuscular junction. It also causes increased acetyl cholinesterase activity. This causes prolonged neuromuscular blockade and paralysis of skeletal muscles.

The secondary objective in our study was to compare the incidence of post operative shivering in both the groups. In the present study, patients in the Magnesium group had less post operative shivering than control group (5 vs 18). The final objective in our study was to compare the consciousness score in both the groups. On the basis of consciousness score both the groups are comparable and no significant difference is seen between the groups (P Value - 0.066). Most of the patients in Magnesium group were drowsy after operation, possibly as Magnesium is known as a central nervous system depressant but this did not prove to be a problem clinically and all patients were awake and alert within 6 hours.

CONCLUSION

From the above study it may be concluded that Magnesium infusion resulted in a steady and smooth reduction in mean blood pressure and reduced heart rate, with no episodes of severe hypotension. There was reduction in duration of surgical time in Magnesium group than in control group, this may be due to better operative field in Magnesium group. The incidence of postoperative shivering was less in Magnesium group than in control group. Consciousness score was almost same in both the groups and no significant difference was noted.

REFERENCE

1. Fawcett WJ, Haxby EJ, Male DA. Magnesium: physiology and pharmacology. Br J Anaesth 1999;83: 302-20.
2. James MFM. Clinical use of magnesium infusions in anesthesia. Anesth Analg 1992; 74: 129–36.
3. Reinhart, RA. Clinical correlates of the molecularand cellular actions ofmagnesium on the cardiovascular system. Am Heart J. 1991; 121: 1513–1521.
4. Sanders, GM and Sim, KM. Is it feasible to use magnesium sulphate as a hypotensive agent in oral and maxillofacial surgery?. Ann Acad Med Singapore. 1998; 27: 780–785.

5. Crozier, TA, Radke, J, Weyland, A et al. Haemodynamic and endocrine effects of deliberate hypotension with magnesium sulphate for cerebral-aneurysmsurgery. Eur J Anaesthesiol. 1991; 8: 115–121.
6. Dubé, L and Granry, JC. Thetherapeutic use of magnesium in anesthesiology,intensive care and emergency medicine: a review. Can J Anesth. 2003; 50: 732–746
7. Frakes, MA and Richardson, LE. Magnesium sulfate therapy in certain emergency conditions. Am J Emerg Med. 1997; 15: 182–18762.
8. Jacobi, KE, Bohm, BE, Rickauer, AJ, Jacobi, C, and Hemmerling, TM. Moderate controlled hypotension with sodium nitroprusside does not improve surgical conditions or decrease blood loss in endoscopic sinus surgery. J ClinAnesth. 2000; 12: 202–207.
9. Nakaigawa, Y, Akazawa, S, Shimizu, R et al. Effects of magnesium sulphate on the cardiovascular system, coronary circulation, myocardial metabolism inanaesthetized dogs. Br J Anaesth. 1997; 79: 363–368.
10. Ludbrook, GL, James, MF, and Upton, RN. The effect of magnesium sulfate on cerebral blood flow velocity, cardiovascular variables, and arterial carbondioxide tension in awake sheep. J Neurosurg Anesthesiol. 1999; 11: 96–101.
11. N. M. Elsharnouby & M. M. Elsharnouby. Magnesium sulphate as atechnique of hypotensive anaesthesia. British journal of Anaesthesia 2006;96:727–731.
12. J.-HRyu, M.-HKang, K.S.Park, S.HDo Effects of magnesium sulfate on intraperative anaesthetic requirements and postoperative analgesia in gynaecology patients receiving total intravenous anaesthesia British journal of Anaesthesia 2008;100:397-403.
13. Nastou, H, Sarros, G, Nastos, A, Sarrou, V, and Anastassopoulou, J. Prophylactic effects of intravenous magnesium on hypertensive emergencies after cataract surgery. A new contribution to the 63 pharmacological use of magnesium in anaesthesiology. Magnes Res. 1995; 8: 271–276.
14. Delhumeau, A, Granry, JC, Cottineau, C, Bukowski, JG, Corbeau, JJ, and Moreau, X. Comparative vascular effects of magnesium sulphate and nicardipine during cardiopulmonary bypass (French). Ann FrAnesthRéanim. 1995; 14: 149–153.
15. Fuchs-Buder, T and Tassonyi, E. Magnesium sulphate enhances residual neuromuscular block induced by vecuronium. Br J Anaesth. 1996; 76: 565–566.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 15-03-2019; **Accepted:** 19-04-2019; **Published:** 30-04-2019