Effect of single bolus dose of intravenous magnesium sulfate in attenuating hemodynamic stress response to laryngoscopy and nasotracheal intubation in maxillofacial surgeries

Parul Jain[1], Aakansha Bikrol[2], Arora KK[3], Mohan Nema[4]

[1]Associate Professor, [2]Post Graduate Resident, [3]Professor and Head, [4]Assistant Professor, Department of Anaesthesiology, Mahatma Gandhi Memorial Medical College and M.Y. Hospital, Indore, Madhya Pradesh, India

Submission: 04-04-2022 Revision: 28-06-2022 Publication: 01-08-2022

ABSTRACT

Background: Nasotracheal intubation alters respiratory and cardiovascular physiology by reflex response mediated by both sympathetic and parasympathetic nervous systems and by the physical presence of the nasotracheal tube. Hypertension and tachycardia are the most common responses to intubation mediated by sympathetic efferent through cardio accelerator nerve and sympathetic chain ganglia. $MgSO_4$ inhibits catecholamine release from adrenergic nerve endings and adrenal medulla resulting in attenuation of stress response. **Aims and Objectives:** In this study, we observed the effects of $MgSO_4$ on the hemodynamic stress response. **Materials and Methods:** This prospective randomized controlled study was conducted on 60 patients after approval of the Institutional Ethics and Scientific Review committee over the period of 1 year. They were divided into two groups, Group M ($MgSO_4$ group) received 40 mg/kg of intravenous magnesium sulfate in 100 ml normal saline and Group C (control group) received normal saline 10 min before induction. Hemodynamic parameters (HR, SBP, DBP, and MAP) were recorded at baseline, just before induction and at 1, 3, 5, 10, 15, and 30 min after intubation and every 15 min till the end of surgery. **Results:** After conducting this study, we observed that heart rates at 1, 3, 5, and 10 were significantly lower in the M group as compared to the C group ($P<0.05$). Systolic, diastolic, and mean blood pressure were also reduced significantly in the M group as compared to the C group ($P<0.05$). **Conclusion:** Magnesium sulfate when used at the dose of 40 mg/kg attenuates the hemodynamic stress response during laryngoscopy and nasotracheal intubation.

Key words: Nasotracheal intubation; Magnesium sulfate; Hemodynamic stress response

Access this article online

Website:

http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v13i8.44287

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Maxillofacial injuries are frequent presentation in trauma and emergency department, varying from simple, common nasal fractures to gross comminuted fractures of the face.[1] Cranial and cervical structures may also be involved because of close proximity.[1] Most maxillofacial surgeries require surgical interventions which are done under general anesthesia with the insertion of a nasotracheal tube.[2] Nasotracheal intubation is associated with more hemodynamic stress response than orotracheal intubation.[3] The maxillofacial region has high vascularity and its injuries may also involve cranial structures therefore these surgeries require more hemodynamic stability.[4,5]

Nasotracheal intubation alters respiratory and cardiovascular physiology by reflex response mediated by both sympathetic and parasympathetic nervous systems and by the physical

Address for Correspondence:
Dr. Mohan Nema, Assistant Professor, Department of Anaesthesiology, Mahatma Gandhi Memorial Medical College and M.Y. Hospital, Indore - 452 001, Madhya Pradesh, India. **Mobile:** +91-7000020148. **E-mail:** mohannema718@gmail.com

presence of the nasotracheal tube.[6] Hypertension and tachycardia are the most common responses to intubation mediated by sympathetic efferent through cardio accelerator nerve and sympathetic chain ganglia.[6]

Renin-angiotensin system releases renin from renal juxtaglomerular apparatus causing stress response.[7] Other effects are arrhythmias and an increase in intracranial pressure. Many pharmacological agents have been used to attenuate this stress response such as Fentanyl,[8] Esmolol,[9] intravenous lignocaine,[10] Dexmedetomidine,[11] Nitroglycerine,[12] oral Pregabalin,[13] and oral Gabapentine.[13]

Catecholamine release from adrenergic nerve endings and adrenal medulla is inhibited by magnesium sulfate thereby attenuating stress response.[14]

Intravenous magnesium sulfate causes decrease in blood pressure by the various mechanisms like the activation of membrane Ca-ATPase and Na–K ATPase involved in transmembrane ion exchanges during depolarization and re-polarization phases, and thus acts as a stabilizer of the cell membrane and intracytoplasmic organelles.[15] L-type calcium channels in membranes and the sarcoplasmic reticulum are inhibited by magnesium limiting the outflow of calcium from the sarcoplasmic reticulum.[15] In addition, magnesium acts as a vasodilator by increasing the synthesis of Prostacyclin, as well as inhibiting angiotensin-converting enzyme activity.[15]

Many studies have been done to evaluate the effect of magnesium sulfate on hemodynamic stress response; however, very few studies are available to support the data for hemodynamic stress response to laryngoscopy and nasotracheal intubation in maxillofacial surgeries.

The aim of our study is to evaluate the effect of a single bolus dose of intravenous magnesium sulfate on hemodynamic stress response to laryngoscopy and nasotracheal intubation in maxillofacial surgeries.

Aims and objectives

The aim of the study was to study effect of single bolus dose of intravenous magnesium sulfate on hemodynamic stress response to laryngoscopy and nasotracheal intubation in maxillofacial surgeries.

MATERIALS AND METHODS

This prospective randomized controlled study was conducted over the period of 1 year in the Department of Anesthesiology of M.G.M Medical College and M.Y Hospital Indore after approval from Institutional Ethics and Scientific Review committee.

This study was comprised 60 patients belonging to ASA Grade I-II, from age group 18–60 years divided randomly by chit method into two groups. Patient’s refusal or those with a history of cardiovascular, hepatic or renal dysfunction, allergy to study drug, psychiatric illness, pregnant and lactating patients, patient with anticipated difficult airway and any contraindication to nasotracheal intubation were excluded from this study. Magnesium sulfate group as “group M” and Control group as “Group C” with 30 patients in each group scheduled for elective maxillofacial surgery done under general anesthesia.

A thorough pre-anesthetic evaluation of all patients was done. Written informed consent was obtained from all participating patient.

Group M patients (Magnesium Sulfate group) received 40mg/kg of intravenous magnesium sulfate in 100ml normal saline given over 10 min before induction of anesthesia and Group C patients (control group) received 100 ml normal saline 10 min before induction.

When the patient arrived in the operation theater, all baseline hemodynamic parameters (HR, SBP, DBP, MAP, and SpO_2) were recorded and 18G IV cannula was secured and IV fluid ringer lactate was started.

After that, all the patients were premedicated with intravenous inj Gylcopyrolate 0.2 mg and Inj. Midazolam 1 mg.

The patients were pre-oxygenated with 100% oxygen for 5 min through bag and mask. Induction was done with an injection of Fentanyl 2 mcg per kg, injection Propofol 2–3 mg/kg till verbal response was lost and, injection Succinylcholine 1.5 mg/kg. After induction, intubation was done with an appropriate size flexo-metallic endotracheal tube through nasotracheal route.

The tube was secured after confirming bilateral equal air entry in both the lungs. Continuous ventilation was done on volume control mode with tidal volume 6 ml/kg and respiratory rate at 12–14/min.

All the patients were maintained on oxygen and nitrous oxide (50:50), inhalational Isofurane 0.8% and injection Atracurium 0.5 mg/kg as loading dose and 0.1 mg/kg as a maintenance dose in boluses.

All the parameters were measured after giving the study drug/normal saline at 1, 3, 5, 10, 15, and 30 min after intubation and every 15 min till the end of surgery.

At the end of the surgery, residual neuromuscular blockade was reversed with inj. Neostigmine (0.05 mg/kg) and inj.

Glycopyrrolate (0.01 mg/kg) intravenously. Extubation was done if the patients fulfilled the extubation criteria.

Any incidence of hypotension (MAP <60 mm Hg) was treated with inj. Mephenteramine 3 mg IV in incremental doses and fluid boluses 200–300 ml. Any incidence of bradycardia (heart rate <50/min) that required pharmacological intervention was treated with inj. Atropine 0.6 mg IV.

Statistical analysis

In this study, MiniTab Version 17.0 was used for calculating the P values. Comparison means between the two groups was done using unpaired t-test. Descriptive statistics was presented in the form of numbers and percentages. P<0.05 was taken as statistically significant. The final data were presented in the form of tables and graphs.

RESULTS

This prospective randomized study included total of 60 patients scheduled for elective maxillofacial surgery done under general anesthesia, included of 13 female and 47 male patients in with mean age distribution of 33.23±13.33 in control group and 30.93±11.42 in magnesium group. This difference is not significant (Table 1).

The mean weight in control group was 66.20±10.14 kg and in magnesium group; it was 64.60±9.74 kg. The difference was found to be statistically not significant (P=0.536) showing a comparable mean weight between the two groups (Table 2).

In control group, there were 23 (76.7%) patients in ASA Grade I and 7 (23.3%) patients in ASA Grade II and in magnesium sulfate group, there were 27 (90.0%) patients in ASA Grade I and 3 (10.0%) patients in ASA Grade II. There was no statistically significant difference between both the groups with respect to ASA grade (P=0.166), showing that patients are independent of ASA Grading.

The mean heart rate at baseline and pre-induction was comparable between the two groups (P>0.05). It was significantly lower in magnesium sulfate group at 1, 3, 5, and 10 min after induction in comparison to the control group (P<0.05), while at all the other time intervals, the mean heart was comparable between the two groups (P>0.05), although it was lower in magnesium sulfate group at all these time intervals (Figure 1, Table 3).

The comparison of systolic, diastolic, and mean arterial pressure (MAP) between the two groups showed that, their values at baseline and pre-induction were comparable (P>0.05). It was significantly lower in magnesium sulfate group at 1, 3, 5, and 10 min after induction in comparison to the control group (P<0.05), while at all the other time intervals, they were comparable between the two groups (P>0.05) (Figures 2-4 and Tables 4-6).

DISCUSSION

Nasotracheal intubation alters respiratory and cardiovascular physiology by reflex response mediated by both sympathetic and parasympathetic nervous systems and by the physical presence of the nasotracheal tube. Magnesium inhibits release of catecholamine from adrenergic nerve endings and adrenal medulla thus attenuating stress response. This prospective randomized control study on "the Effect of single bolus dose of intravenous Magnesium Sulfate in attenuating hemodynamic stress response to laryngoscopy and nasotracheal intubation in maxillofacial surgeries" conducted over a period of 12 months after Institutional Ethics and Scientific Review committee clearance. In our study, total of 60 patients divided into two groups, 30 patients were taken in each group (Table 3). Group M patients (Magnesium Sulfate group) received 40 mg/kg of intravenous magnesium sulfate and Group C patients (control group) received normal saline 10 min before induction. Heart rate, systolic blood pressure, diastolic blood pressure, and MAP were measured at baseline, after giving the study drug/normal saline just before induction and at 1, 3, 5, 10, 15, and 30 min after intubation and every 15 min till the end of surgery.

In our study, the patients were comparable with respect to demographic profile.

The comparison of mean heart rate between the two groups showed that the mean heart rate at baseline and

Table 1: Distribution of patients according to the age

Age	Control group		Magnesium group	
	No.	%	No.	%
20–30 years	16	53.3	21	70.0
31–40 years	4	13.3	3	10.0
41–50 years	6	20.0	4	13.3
>50 years	4	13.3	2	6.7
Total	30	100.0	30	100.0
Mean age (±SD)	33.23±13.33		30.93±11.42	
t-value, df	0.718, df=58			
P-value	0.476, NS			

Table 2: Comparison of the mean weight (kg)

Group	No.	Weight (kg) (Mean±SD)	t-value	P-value
Control group	30	66.20±10.14	0.623, df=58	0.536, NS
Magnesium group	30	64.60±9.74		

pre-induction was comparable between the two groups (P>0.05). It was significantly lower in magnesium sulfate group at 1, 3, 5, and 10 min after induction in comparison to the control group (P<0.05), while at all the other time intervals, the mean heart rate was comparable between the two groups (P>0.05), although it was lower in magnesium sulfate group at all these time intervals but difference was statistically not significant.

Similar results were found by Elsharnouby and Lsharnou by in 2006 when they conducted a randomized, double-blind, placebo-controlled study on the use of magnesium sulfate for the technique of hypotensive anesthesia. They used magnesium sulfate at the dose of 40 mg/kg i.v. as a bolus before induction of anesthesia followed by 15 mg/kg/hr continuous i.v. infusion during surgery. The same volume of isotonic solution was administered to the control group. Heart rate and MAP were significantly lower in magnesium group as compared to control group (P<0.005).[16]

Our study results were also supported by Puri et al., conducted a study titled "The Effect of Magnesium Sulfate on Hemodynamics and Its Efficacy in Attenuating the Response to Endotracheal Intubation in Patients with Coronary Artery Disease" in 1998. They used magnesium sulfate (50 mg/kg) in Group M and Group B (n=17) received isotonic Saline before the induction of anesthesia. An increase in cardiac index (P<0.01), a minimal increase in

Table 3: Comparison of mean heart rate between the two groups

Heart Rate	Control group (Mean±SD)	Magnesium group (Mean±SD)	P-value
Baseline HR	86.93±10.86	85.07±9.48	0.481, NS
Preinduction HR	87.1±11.07	82.73±9.14	0.101, NS
1 min after induction HR	86.03±10.49	80.67±7.26	0.025*
3 min after induction HR	87.87±11.62	81.2±8.9	0.015*
5 min after induction HR	87.47±12.09	80.63±8.33	0.013*
10 min HR	84.43±13.53	78.87±6.75	0.048*
15 min HR	87.27±13.15	82.38±8.78	0.100, NS
30 min HR	84.4±9.62	80.1±8.05	0.068, NS
45 min HR	83.03±10.64	78.35±10.91	0.100, NS
60 min HR	84.3±9.3	79.76±9.44	0.068, NS
75 min HR	83.2±9.2	79.35±7.77	0.088, NS
90 min HR	84.44±10.49	82.07±7.2	0.345, NS
105 min HR	84.83±7.37	81.2±7.4	0.216, NS
120 min HR	92.75±26.73	78.38±7.01	0.157, NS

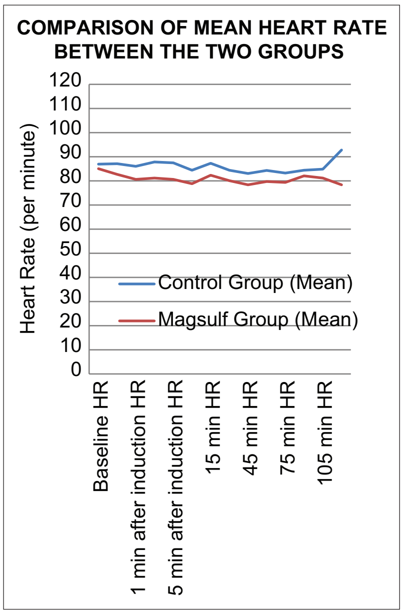

Figure 1: Line diagram showing comparison heart rate

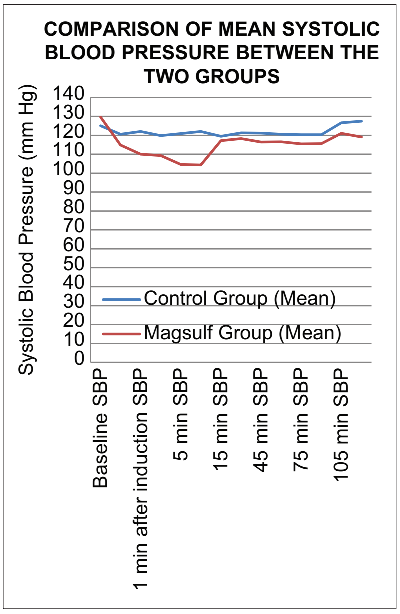

Figure 2: Line diagram showing of mean comparison of mean SBP

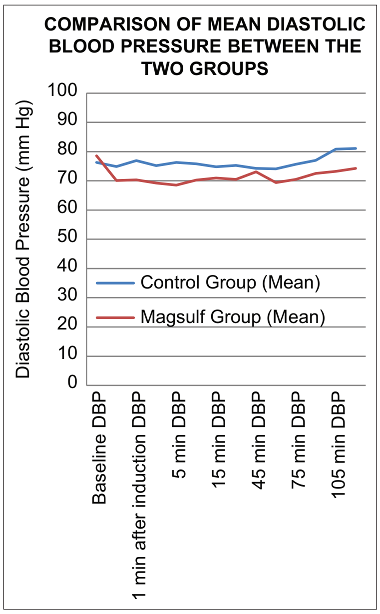

Figure 3: Line diagram showing comparison of DBP

heart rate and a significant decrease in MAP and systemic vascular resistance (P<0.001) were found in Group A as compared to Group B. In our study, heart rate was also significantly lower in magnesium sulfate group.[17]

The comparison of systolic, diastolic, and MAP between the two groups showed that their values at baseline and pre-induction were comparable (P>0.05). It was significantly lower in magnesium sulfate group at 1, 3, 5, and 10 min after induction in comparison to the control group (P<0.05), while at all the other time intervals, they were comparable between the two groups (P>0.05). These observations were supported by Honarmand et al., in 2015 when they conducted a study on different doses of intravenous magnesium sulfate on cardiovascular changes following the laryngoscopy and tracheal intubation. 120 patients, divided equally into four groups (*n*=30) and received different doses of $MgSO_4$ in case (Group I: 30 mg/kg, Group II: 40 mg/kg, and Group III: 50 mg/kg) and equal volume of normal saline in control group. The mean SBP, DBP, and MAP at 1, 3, and 5 min after laryngoscopy were significantly less in Group I, Group II, and Group III compared with Group S, most significant difference was found in Group III (P<0.005). Results showed that using all doses of $MgSO_4$ significantly decreased the SBP, DBP, and MBP at 3, 5, and 10 min after laryngoscopy as compared with control group.[18]

Effect of magnesium sulfate on blood pressure changes was also observed by Biswas et al. (2015) when they conducted a randomized control study on "Effects of

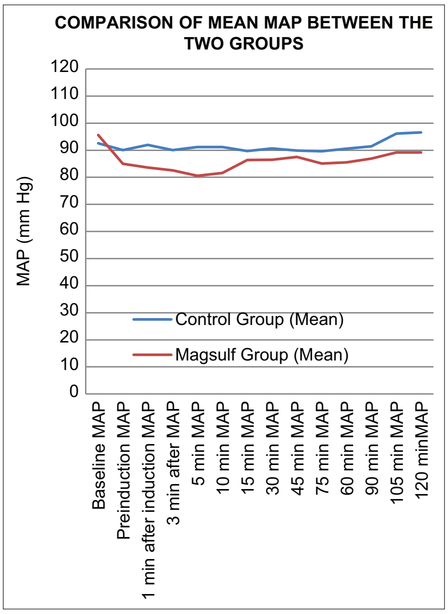

Figure 4: Line diagram showing MAP

Table 4: Comparison of mean systolic blood pressure between the two groups

Systolic blood pressure	Control group (Mean±SD)	Magnesium group (Mean±SD)	P-value
Baseline SBP	125.07±11.92	129.63±17.44	0.241, NS
Preinduction SBP	120.53±15.34	114.83±3.92	0.053, NS
1 min after induction SBP	122.03±16.8	110.03±7.49	0.001*
3 min after SBP	119.83±13.23	109.33±9.09	0.001*
5 min SBP	120.97±13.69	104.57±4.64	0.001*
10 min SBP	122.03±12.11	104.37±4.39	0.001*
15 min SBP	119.53±14.31	117.13±11.97	0.484, NS
30 min SBP	121.33±8.85	118.3±16.38	0.376, NS
45 min SBP	121.23±11.2	116.43±12.15	0.117, NS
60 min SBP	120.57±8.25	116.53±9.16	0.078, NS
75 min SBP	120.3±9.83	115.47±9.06	0.052, NS
90 min SBP	120.28±10.64	115.59±7.94	0.076, NS
105 min SBP	126.67±10.03	121.00±4.04	0.056, NS
120 min SBP	127.5±9.84	119.13±9.34	0.073, NS

Table 5: Comparison of mean diastolic blood pressure between the two groups

Diastolic blood pressure	Control group (Mean±SD)	Magsulf group (Mean±SD)	P-value
Baseline DBP	76.27±10.71	78.57±16.87	0.531, NS
Preinduction DBP	74.87±11.95	70.13±6.42	0.61, NS
1 min after induction DBP	76.9±10.42	70.37±9.32	0.013*
3 min after DBP	75.17±12.74	69.23±8.87	0.041*
5 min DBP	76.27±14.78	68.57±7.83	0.014*
10 min DBP	75.8±12.96	70.23±6.30	0.039*
15 min DBP	74.83±12.28	71±9.76	0.186, NS
30 min DBP	75.27±10.28	70.53±9.63	0.071, NS
45 min DBP	74.23±12.19	73.07±9.63	0.682, NS
60 min DBP	74.1±9.49	69.37±9.74	0.062, NS
75 min DBP	75.67±12.23	70.53±7.87	0.058, NS
90 min DBP	77±11.44	72.52±6.05	0.080, NS
105 min DBP	80.83±11.3	73.27±9.14	0.066, NS
120 min DBP	81.08±9.96	74.25±10.79	0.163, NS

Table 6: Comparison of mean MAP between the two groups

Mean MAP	Control group (Mean±SD)	Magsulf group (Mean±SD)	P-value
Baseline MAP	92.53±10.2	95.59±16.4	0.390, NS
Preinduction MAP	90.09±11.69	85.03±4.96	0.033*
1 min after induction MAP	91.94±11.07	83.59±6.05	0.001*
3 min after MAP	90.06±11.24	82.6±6.95	0.003*
5 min MAP	91.17±12.67	80.57±5.25	0.000*
10 min MAP	91.21±10.53	81.61±4.66	0.000*
15 min MAP	89.73±10.14	86.38±9.38	0.188, NS
30 min MAP	90.62±9.18	86.46±10.8	0.113, NS
45 min MAP	89.9±11.44	87.52±9.31	0.381, NS
60 min MAP	89.59±8.75	85.09±8.78	0.051, NS
75 min MAP	90.54±11.28	85.51±7.72	0.048*
90 min MAP	91.43±9.42	86.88±6.03	0.042*
105 min MAP	96.11±10.44	89.18±5.85	0.038*
120 min MAP	96.56±9.21	89.21±9.34	0.099, NS

Magnesium Sulfate on hemodynamic response to carbon dioxide pneumoperitoneum in patients undergoing laparoscopic cholecystectomy." 60 patients divided into two groups, Group M patients received magnesium sulfate 30 mg/kg intravenously as a bolus and Group C received same volume of 0.9% saline. Result showed that MAP values in Group M were significantly lower than the C group ($P<0.05$).[19]

In our study, only one patient in the magnesium group experienced bradycardia which did not require any intervention. There was no incidence of hypotension in either of the groups. In our study there were total of 60 patients, 30 in magnesium group, and 30 in Control group. There were no dropouts in our study.

Limitations of the study

Although this study has tried to meet its aims and objectives in all aspect, there are few limitations to it. We conducted a single-center study, we have taken short duration surgeries. Sample size should have been more for better conclusive result.

CONCLUSION

From our study, it can be concluded that the injection magnesium sulfate given at the dose of 40 mg/kg intravenously attenuates stress response during laryngoscopy and nasotracheal intubation.

ACKNOWLEDGMENT

This research was supported by Mahatma Gandhi Memorial Medical College and M.Y. Hospital, Indore - 452 001, Madhya Pradesh, India. We are thankful to Dr. K.K. Arora Professor and HOD, Department of Anaesthesia for his guidance.

REFERENCES

1. Jose A, Nagori SA, Agarwal B, Bhutia O and Roychoudhury A. Management of maxillofacial trauma in emergency: An update of challenges and controversies. J Emerg Trauma Shock. 2016;9(2):73-80.
https://doi.org/10.4103/0974-2700.179456
2. Prasanna D, Bhat S. Nasotracheal intubation: An overview. J Maxillofac Oral Surg. 2014;13(4):366-372.
https://doi.org/10.1007/s12663-013-0516-5
3. Xue FS, Li CW, Sun HT, Liu KP, Zhang GH, Xu YC, et al. The circulatory responses to fibreoptic intubation: A comparison of oral and nasal routes. Anaesthesia. 2006;61(7):639-645.
https://doi.org/10.1111/j.1365-2044.2006.04685.x
4. Meegalla N, Sood G, Nessel TA and Downs BW. Anatomy, head and neck, facial arteries. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2022.
5. Flanagan D. Important arterial supply of the mandible, control of an arterial hemorrhage, and report of a hemorrhagic incident. J Oral Implantol. 2003;29(4):165-173.
https://doi.org/10.1563/1548-1336(2003)029<0165:iasotm>2.3.co;2
6. Vallabha R and Muthayala VK. Attenuating the haemodynamic stress to laryngoscopy and intubation with I.V. magnesium sulphate and lignocaine-comparative study. IOSR J Dent Med Sci. 2018;17(4):1-5.
7. Wu CH, Moradi SM, Chen JZ, Sawada H, Daugherty A and Lu HS. Renin-angiotensin system and cardiovascular functions. Arterioscler Thromb Vasc Biol. 2018;38(7):e108-e116.
8. Swarnamba UN, Veena K and Shaikh SI. Comparison of the efficacy of lornoxicam and fentanyl in attenuating the hemodynamic response to laryngoscopy and intubation. Anesth Essays Res. 2016;10(3):478-482.
https://doi.org/10.4103/0259-1162.177521
9. Jangra K, Malhotra SK, Gupta A and Arora S. Comparison of quality of the surgical field after controlled hypotension using esmolol and magnesium sulfate during endoscopic sinus surgery. J Anaesthesiol Clin Pharmacol. 2016;32(3):325-328.
https://doi.org/10.4103/0970-9185.173400
10. Kamal JS, Devi RK and Sellappan P. A study on comparison between dexmedetomidine and magnesium sulphate in controlled hypotension during functional endoscopic sinus surgery under general anaesthesia. IJCMR. 2018;5(11):K7-K11.
https://doi.org/10.21276/ijcmr.2018.5.11.22
11. Kotwani DM, Kotwani MB and Hiwarkar A. A prospective randomised study comparing intravenous magnesium sulphate and sublingual nitroglycerine spray in attenuating haemodynamic responses to laryngoscopy and intubation. Int J Clin Trials. 2018;5(2):90-96.
https://doi.org/10.18203/2349-3259.ijct20181396
12. Doddaiah DB, Singh NR, Fatima N, Singh SS, Singh HK and Singh KS. A comparative study of oral pregabalin and oral gabapentin in the attenuation of hemodynamic response to laryngoscopy and intubation. J Med Society Year. 2017;31(1):14-18.
https://doi.org/10.4103/0972-4958.198428
13. El Mourad MB and Arafa SK. Effect of intravenous versus intraperitoneal magnesium sulfate on hemodynamic parameters and postoperative analgesia during laparoscopic sleeve gastrectomy-A prospective randomized study. J Anaesthesiol Clin Pharmacol. 2019;35(2):242-247.
https://doi.org/10.4103/joacp.joacp_208_18
14. Tramer MR, Schneider J, Marti RA and Rifat K. Role of magnesium sulfate in postoperative analgesia. Anesthesiology. 1996;84(2):340-347.
https://doi.org/10.1097/00000542-199602000-00011
15. Wang H, Yang B, Han GW and Li ST. Potency of nondepolarizing muscle relaxants on muscle-type acetylcholine receptors in denervated mouse skeletal muscle. Acta Pharmacol Sin. 2010;31:1541-1546.
https://doi.org/10.1038/aps.2010.163
16. Elsharnouby NM and Elsharnouby MM. Magnesium sulphate as a technique of hypotensive anaesthesia. Br J Anaesth. 2006;96(6):727-731.
https://doi.org/10.1093/bja/ael085
17. Puri GD, Marudhachalam KS, Chari P and Suri RK. The effect of magnesium sulphate on hemodynamics and its efficacy in attenuating the response to endotracheal intubation in patients with coronary artery disease. Anesth Analg. 1998;87(4):808-811.
https://doi.org/10.1213/00000539-199810000-00012

18. Honarmand A, Safavi M, Badiei S and Daftari-Fard N. Different doses of intravenous Magnesium sulfate on cardiovascular changes following the laryngoscopy and tracheal intubation: A double-blind randomized controlled trial. J Res Pharm Pract. 2015;4(2):79-84.
https://doi.org/10.4103/2279-042x.154365
19. Paul S, Biswas P, Bhattacharjee DP and Sengupta J. Effects of magnesium sulfate on hemodynamic response to carbon dioxide pneumoperitoneum in patients undergoing laparoscopic cholecystectomy. Anesth Essays Res. 2013;7(2):228-231.
https://doi.org/10.4103/0259-1162.118970

Authors Contribution:
PJ - Concept and design of the study, prepared first draft of manuscript; **AB, AKK -** Interpreted the results; reviewed the literature, and manuscript preparation; **MN-**Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the manuscript

Work attributed to:
Mahatama Gandhi Memorial Medical College and M.Y. Hospital, Indore - 452 001, Madhya Pradesh, India.

Orcid ID:
Dr. Parul Jain - https://orcid.org/0000-0002-8834-3299
Dr. Aakansha Bikrol - https://orcid.org/0000-0002-5625-8591
Dr. Arora KK - https://orcid.org/0000-0002-7376-4322
Dr. Mohan Nema - https://orcid.org/0000-0001-6818-9258

Source of Support: Nil, **Conflicts of Interest:** None declared.