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

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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. MgSO4 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 MgSO4 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 (MgSO4 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

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
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.

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

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

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. L-type calcium channels in membranes and the sarcoplasmic reticulum are inhibited by magnesium limiting the outflow of calcium from the sarcoplasmic reticulum. In addition, magnesium acts as a vasodilator by increasing the synthesis of Prostacyclin, as well as inhibiting angiotensin-converting enzyme activity.

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.
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, 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
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).

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

![Figure 1: Line diagram showing comparison heart rate](image1.png)

![Figure 2: Line diagram showing mean comparison of mean SBP](image2.png)

![Figure 3: Line diagram showing comparison of DBP](image3.png)

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          | 87.14±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 |
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 MgSO₄ 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 MgSO₄ 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

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            | 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±12.69            | 104.57±4.64               | 0.001*   |
| 10 min SBP              | 122.03±12.11            | 104.37±4.39               | 0.001*   |
| 15 min SBP              | 119.53±43.14            | 117.33±11.97              | 0.484, NS |
| 30 min SBP              | 121.33±8.85             | 118.33±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±8.93              | 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             | 127.54±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) | Magnesium 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±4.42                | 0.61, NS  |
| 1 min after induction DBP | 76.9±10.42              | 70.37±3.92                | 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±7.6                  | 0.016, NS |
| 30 min DBP              | 75.27±10.28             | 70.53±6.63                | 0.071, NS |
| 45 min DBP              | 74.23±12.19             | 73.07±9.63                | 0.062, NS |
| 60 min DBP              | 74.1±9.49               | 69.37±7.4                 | 0.058, NS |
| 75 min DBP              | 75.67±12.23             | 70.53±7.8                 | 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) | Magnesium group (Mean±SD) | P-value |
|----------|-------------------------|---------------------------|---------|
| Baseline MAP | 92.5±10.23             | 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           | 91.75±12.67            | 80.5±7.25                 | 0.000*   |
| 10 min MAP          | 91.21±10.53            | 81.6±4.86                 | 0.000*   |
| 15 min MAP          | 89.7±10.14             | 86.3±8.98                 | 0.188, NS |
| 30 min MAP          | 90.62±9.18             | 86.4±10.8                 | 0.113, NS |
| 45 min MAP          | 89.9±11.44             | 87.5±2±9.31               | 0.381, NS |
| 60 min MAP          | 89.5±9±7.5             | 85.0±9.7±8                | 0.051, NS |
| 75 min MAP          | 90.5±11.28             | 85.5±1±7.7                | 0.048*   |
| 90 min MAP          | 91.4±9.42              | 86.8±8.6                  | 0.042*   |
| 105 min MAP        | 96.1±10.44             | 89.1±6.88                 | 0.038*   |
| 120 min MAP        | 96.5±9.21              | 89.2±9.34                 | 0.095, 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).

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.

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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.

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