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A STUDY TO COMPARE INTRAVENOUS NITROGLYCERINE AND MAGNESIUM SULPHATE FOR ATTENUATING THE HAEMODYNAMIC STRESS RESPONSE TO LARYNGOSCOPY AND ENDOTRACHEAL INTUBATION

The article is devoted to monitoring the condition of the respiratory tract during general anesthesia, which is the most important duty of an anesthesiologist. Despite advances in airway monitoring devices, rigid laryngoscopy and intubation remain preferred methods. Airway treatment during intubation causes a hemodynamic reaction due to stimulation of the upper respiratory tract, which leads to an increase in catecholamine levels, which leads to hypertension, tachycardia and rhythm disturbances. This reaction reaches its maximum immediately after intubation and usually lasts 5-10 minutes. Despite the successful use of both nitroglycerin for intravenous administration and magnesium sulfate for this purpose, there is currently no direct comparison of these two drugs in the literature with respect to attenuation of hemodynamic changes during laryngoscopy and intubation. Therefore, our research is aimed at conducting such a comparative study. The study was a double-blind, prospective, randomized study involving sixty patients aged 18 to 60 years who were scheduled for surgery requiring general anesthesia and endotracheal intubation, with the status of asa I and II.Both intravenous administration of MgSO4 (30 mg/kg) and NTG (1 mcg/kg) were effective in attenuating the pressor reaction caused by laryngoscopy and endotracheal intubation. However, MgSO4 was significantly superior to NTG in reducing heart rate.

Key words: Airway management, general anaesthesia, nitroglycerine, magnesium sulphate, haemodynamic stress.

Introduction

Airway management during general anaesthesia is a crucial responsibility of an anaesthesiologist. Despite advancements in airway devices, rigid laryngoscopy and intubation remain the preferred technique [1,2]. Airway handling during intubation causes hemodynamic response due to upper airway stimulation, leading to increased catecholamine levels which results in hypertension, tachycardia, and rhythm disturbances. This response peaks immediately after intubation and typically lasts 5-10 minutes [3,4]. While healthy individuals generally tolerate this response, hypertensive patients or those with ischemic heart disease are at higher risk of complications like myocardial ischemia, intracranial pressure changes, hemorrhage, and cardiac failure [5]. Pharmacological strategies to mitigate this pressor response include topical or intravenous lignocaine, opioids (e.g. fentanyl, alfentanil, remifentanil), alpha- and beta-adrenergic blockers (e.g. esmolol), calcium channel blockers (e.g. diltiazem and verapamil), vasodilators (e.g. nitroglycerine), and alpha-2 agonists (e.g. clonidine, dexmedetomidine). Magnesium sulphate, traditionally used in eclampsia, has emerged as another option to reduce the pressor response of intubation by inhibiting catecholamine release. This mechanism reduces serum epinephrine levels, decreasing atrial contraction, bradycardia, and vasodilation [6, 7]. Nitroglycerine, acting on vascular smooth muscle, induces dilatation of veins and arterioles. Due to its rapid metabolism and non-toxic nature, it has been effectively utilized to mitigate the pressor response triggered by airway handling during intubation at doses of 1 mcg/kg and 2 mcg/kg [8]. Despite the successful use of both intravenous nitroglycerine and magnesium sulphate for this purpose, there is currently a lack of direct comparison in the literature between these two agents in blunting the hemodynamic changes during laryngoscopy and intubation. Therefore, our study aims to conduct such a comparative investigation.

Methods

We conducted a double-blind, prospective randomized trial and enrolled sixty patients who were planned for any surgery requiring general anaesthesia administration and endotracheal intubation in ASA status I and II in the age group of 18 to 60. The Institutional Ethics Committee approval was obtained, and patients' enrolment was started after that. Exclusion criteria encompassed declining to participate, those with anticipated difficult airways, seizure disorders, BMI > 30 kg/meter square, drug allergies, and individuals with poor cardiopulmonary reserves. Additionally, patients taking antidepressants, antipsychotics, beta-blockers, or antihypertensive medications, as well as pregnant patients, were excluded from the study.

The purpose of the study and protocol were thoroughly explained to all the patients and informed written consent for participation in the trial was taken. Fasting instructions were given to patients as per the latest institutional policy which is six hours for solid food and two hours for clear fluid before the scheduled surgery. The night before the surgery, they were premedicated with an orally administered tablet of alprazolam (0. 25 mg) and pantoprazole (40 mg). Baseline readings of vital parameters were recorded upon arrival of the patient in the operating room {B1}. Patients were randomized using computer-based randomization into two groups of 30 patients each. Group 1 received intravenous magnesium sulphate (MgSO4) at a dose of 30 mg/kg in 10 ml of saline over 5 minutes before induction. Group 2 patients received intravenous nitroglycerine (NTG) at a dose of 1 mcg/kg in 10 ml of saline over the same duration before induction. Throughout the drug infusion, all patients underwent pre-oxygenation for 3 minutes. Following the completion of the infusions, standard anaesthesia techniques were employed for induction in both groups, involving the administration of fentanyl, thiopentone sodium, and vecuronium. Subsequently, direct laryngoscopy was performed using Macintosh blade, and endotracheal intubation was performed by an experienced anaesthesiologist, followed by connection to the ventilator. Study parameters were recorded at baseline, post-drug administration, pre-laryngoscopy, and at 1 minute (T1), 3 minutes (T3), and 5 minutes (T5) after intubation. Anaesthesia maintenance was achieved using a combination of nitrous oxide in oxygen (50:50) and sevoflurane titrated to 1 MAC. Upon completion of the surgical procedure, residual neuromuscular blockade was reversed with neostigmine and glycopyrrolate, followed by extubation.

Data was entered into a Microsoft Excel spreadsheet and statistical analysis was performed using IBM SPSS Version 25. Descriptive statistics, including percentages, means, and standard deviations, were computed. Kolmogorov-Smirnov test was used to assess Normality of data. The unpaired t-test was utilized for quantitative data comparison between two independent observations, while the chi-square test was employed for qualitative data comparison of all clinical indicators. $P \leq 0.05$ was considered significant.

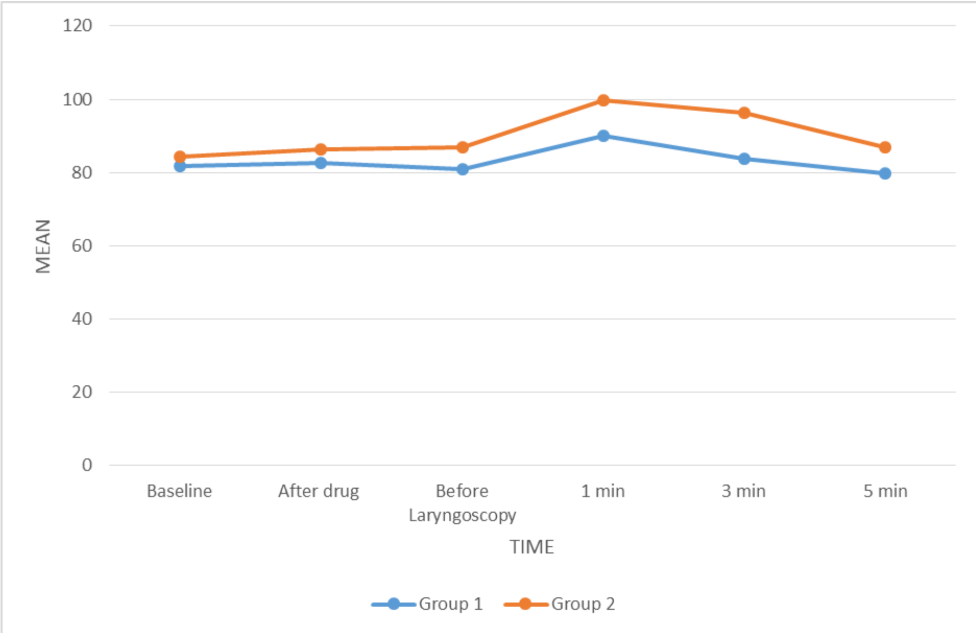
Results

The baseline status of the enrolled patients in the two groups is depicted in Table 1. There was no significant difference observed between the two groups in terms of age, sex, body mass index (BMI), or difficulty of intubation assessed preoperatively by mallampati grading (MPG).

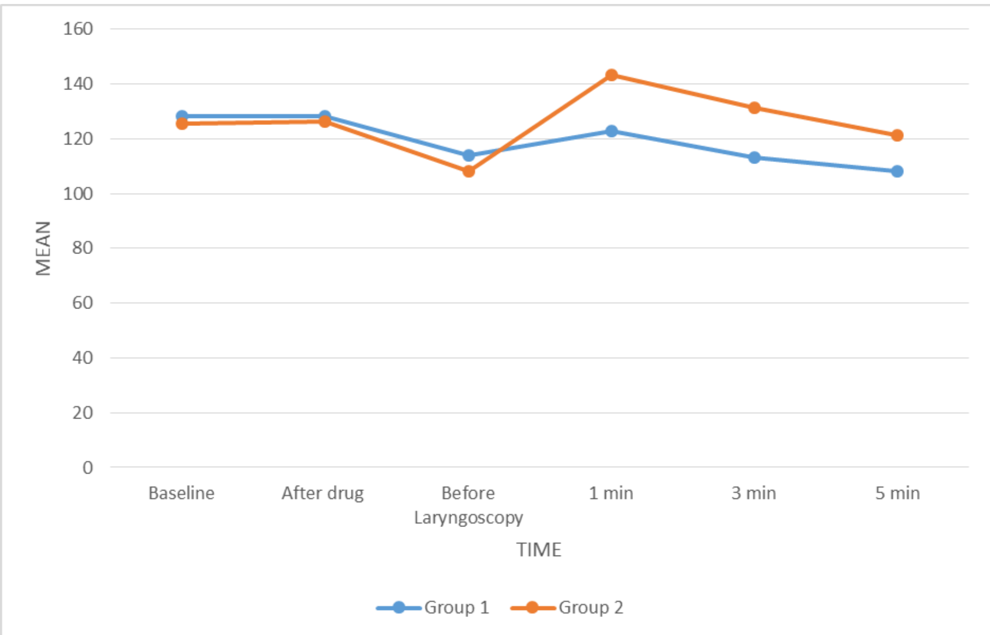
Table 1 – Baseline status of enrolled patients

	Magnesium group	NTG group	P value
Age (Mean ± SD)	32.7 ± 12.7	35.4 ± 13.2	0.42
Males (%age)	46.7 %	40 %	0.6
Females (%age)	53.3 %	60 %	
BMI (mean ± SD)	23.7 ± 2.3	25.1 ± 6.7	0.29
ASA status (n)			
Status I	19	12	0.07
Status II	11	18	
MPG grade (n)			
Grade I	11	8	0.21
Grade II	17	22	
Grade III	2	0	

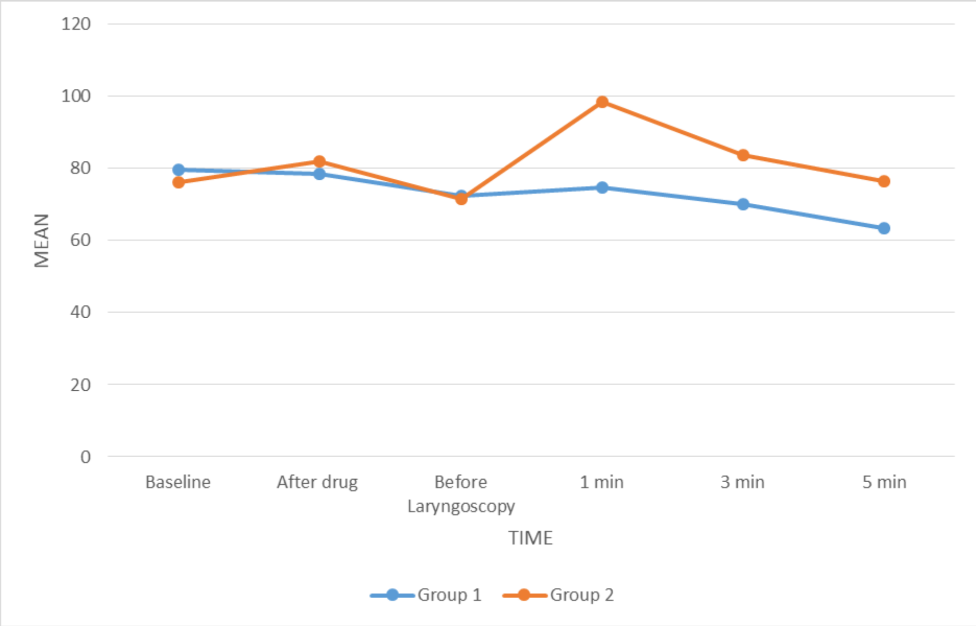
The heart rate in both groups was similar at baseline, after administering the study drug, and before laryngoscopy. However, there was a statistically significant decrease in heart rate in Group 1 (Magnesium sulphate group) when compared to Group 2 at 1, 3, and 5 minutes after intubation (Graph 1). Similarly, we found that there was lower systolic, diastolic and mean blood pressure after intubation at 1, 3 and 5 minutes in Magnesium sulphate group (Group 1) when compared to the nitroglycerine group (group 2) which was statistically significant. Also, in both the groups the blood pressure values were similar statistically at baseline, after giving the drug, and before laryngoscopy. (Graph 2,3, and 4)



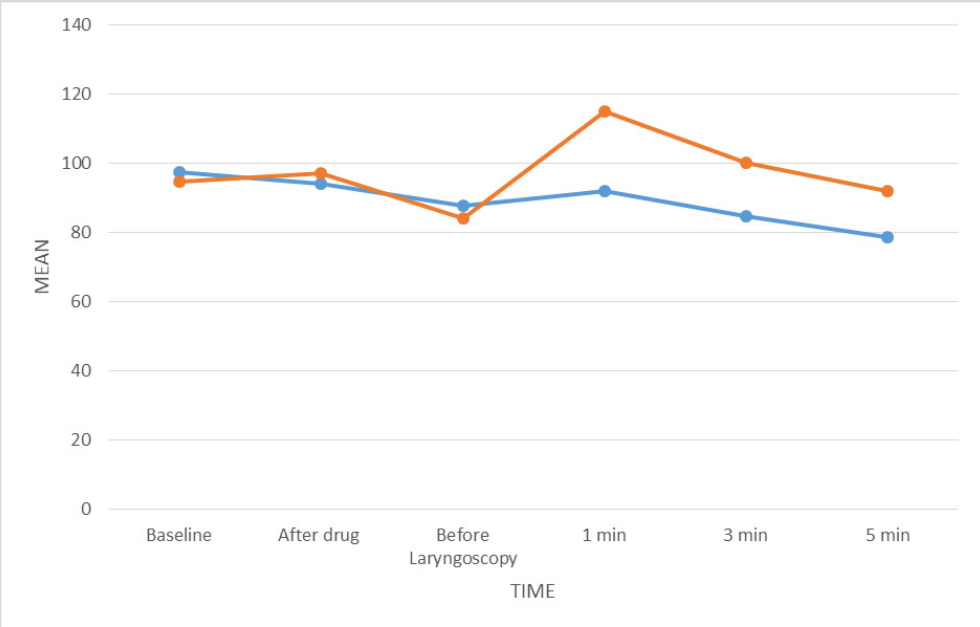
Graph 1 – Statistically significant decrease in heart rate



Graph 2 – The blood pressure values the group that took nitroglycerin



Graph 3 – The blood pressure values after giving the drug



Graph 4 – The blood pressure values before laryngoscopy

Discussion

Laryngoscopy and intubation often trigger a sympathetic pressor response, resulting in approximately a 20% increase in heart rate and a 40-50% rise in blood pressure. Healthy patients typically tolerate this response well however, hypertensive individuals may suffer from such hypertensive effects which may cause episodes of MI, arrhythmia, or intracranial events. Therefore, it is highly desirable to attenuate this pressor response to airway manipulation in such high-risk patients. [10] Intravenous magnesium sulphate (30-50 mg/kg) has been extensively studied and effectively utilized to mitigate the hemodynamic stress response to laryngoscopy and intubation. Similarly, intravenous nitroglycerine (1-2 mcg/kg) has also been shown in numerous studies to blunt the hemodynamic stress response.

Despite their effectiveness, there has been no direct comparison between intravenous nitroglycerine and magnesium sulphate on the pressor response associated with laryngoscopy and endotracheal intubation. Thus, we conducted this study to compare magnesium sulphate and nitroglycerine in this context.

Our findings reveal that intravenous MGSO4 is superior to NTG for blunting the pressor response associated with laryngoscopy and endotracheal intubation as we found in this trial that patients who received MGSO4 experienced greater attenuation of stress response as compared to those who received NTG.

Our findings align with the results of a study done by Nandal S et al., where MGSO4 was demonstrated to effectively blunt the pressor response due to airway manipulation caused by laryngoscopy. They administered MGSO4 in a dose of 30mg/kg and 40mg/kg prior to anaesthesia induction. They observed that compared to baseline values, the increase in HR and BP associated with the laryngoscopy and intubation was not significant in all the groups. So, they concluded in their trial that magnesium sulphate in the dose of 30mg/kg effectively controls the hemodynamic stress response during intubation [9].

Kasar et al., compared intravenous MGSO4 and lignocaine for the blunting of haemodynamic response to laryngoscopy. Statistically significant reduction in HR was observed at an interval of 1, 3, and 5 minutes after intubation in the MGSO4 group [10]. Similarly, Jain P et al. found that MGSO4 significantly attenuates the stress response associated with laryngoscopy and nasotracheal intubation [11]. Kiran KN showed that MGSO4 significantly blunts the stress response following the laryngoscopy and endotracheal intubation. MGSO4 was given in a dose of 50 mg/kg intravenously 60 seconds prior to intubation. Mild transient tachycardia was there in study group which settled back to near preinduction values. Similarly, in our study HR settled back to baseline values in the magnesium group [12]. The findings of our study align with results demonstrated by Kesar et al, and Kiran et al. Our findings are also in coherence with Azim H et al, who studied the effect of different doses of intravenous MGSO4 on laryngoscopy-associated haemodynamic response. Variations in HR were not significantly reported amongst groups in the study. However, changes in SBP, DBP and MAP were found to be significantly lower at 1, 3 and 5 minute intervals in the group who received magnesium sulphate compared to the control group.[7]

Our findings are in contrast with those of Kotwani DM et al., who compared intravenous MGSO4 and NTG spray via sublingual route for blunting the hemodynamic stress response during laryngoscopy. They found that heart rate and BP in both groups increased during laryngoscopy however the difference was statistically not significant at any time points. Thus, author concluded that intravenous magnesium sulphate and sublingual nitroglycerine spray are equally effective for blunting of pressor response to laryngoscopy. [6]

The action of MGSO4 involves several mechanisms:[10]

1. Inhibits neurotransmitter release at the presynaptic level in a dose-dependent manner.

2. Physiological and pharmacological NMDA blocker action in neuronal tissue.

3. Smooth muscle relaxation, peripheral vasodilation, and decreased vascular resistance, thus promoting hemodynamic stability.

4. Decreases catecholamine release from adrenergic nerve terminals.

5. Antiarrhythmic properties.

In our study, we did not observe any adverse event in any of the patients in either group. However, our study had several limitations; first of all, we did not included high risk ASA status III and IV patients in our trial. We also did not included anticipated difficult airway patients, including MPG IV; and also did not measured the laryngoscopy duration in our study. There is a propensity for increased duration of laryngoscopy including multiple attempts at intubation in difficult airway cases which would have an exaggerated impact on the haemodynamic stimulation. In the wake of above limitations, the results of our study are not generalisable to all groups of patients. We also did not use any anaesthesia depth monitor before attempting laryngoscopy. Patients at different depths of anaesthesia would have different levels of haemodynamic stimulation with a lighter depth of anaesthesia patients having higher stimulation.

Conclusion

Both intravenous MgSO4 (30 mg/kg) and NTG (1mcg/kg) were effective for attenuation of pressor response caused by laryngoscopy and endotracheal intubation. However, MgSO4 was significantly superior to NTG in attenuating heart rate, systolic BP, diastolic BP, and mean arterial pressure variations associated with the laryngoscopy.

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