Comparative Study of Attenuation of Cardiovascular Responses to Laryngoscopy and Intubation, Employing $MgSO_4$ Vs Normal Saline - A Randomized Double Blinded Study

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ABSTRACT

Introduction: Endotracheal intubation is often associated with a hypertension and tachycardia. Intravenous $MgSO_4$ is a popular method of blunting this response, because of its ability to depress sympathoadrenal response and catacholamine release. Objective of the study was to compare the effects of 50mg/kg $MgSO_4$ IV given 3 minutes before laryngoscopy and intubation.

Material and Methods: A sample size of 60 patients aged 18 to 60 yrs were included in the study and they were allocated into 2 groups of n=30 each. Group I served as control. Group II received 50 mg/kg of IV magnesium sulphate 3 min before induction. HR, SBP were recorded pre-operatively, 30 sec, 1 min, 3min and 5min after intubation.

Results : Patient receiving iv $MgSO_4$ had a better intubating conditions ($p<0.04$) statistically significant than in Group I. There was an increase in the HR at 1 minute after intubation compared to basal value ($p < 0.01$). Also, a decrease in SBP observed at 1 minute and 3 min after intubation when compared with basal value ($p < 0.001$) and ($p<0.001$) respectively. The decrease in RPP at 1 minute and 3 minutte after intubation when compared with the basal value ($p <0.001$)and ($p<0.01$) respectively

Conclusion: Magnesium sulphate 50 mg/kg IV infusion 3 minutes before induction, is a simple, effective and practical method of blunting cardiovascular responses to tracheal intubation, not associated with any adverse effect.

Key Words: Cardiovascular Responses, laryngoscopy, $MgSO_4$

INTRODUCTION

Direct laryngoscopy and endotracheal intubation following induction of anesthesia is almost always associated with hemodynamic changes due to reflex sympathetic discharge caused by epipharyngeal and laryngopharyngeal stimulation.[1] This increased sympatho-adrenal activity may result in hypertension, tachycardia and arrhythmias.[2-4] This increase in blood pressure and heart rate are usually transitory, variable and unpredictable. Hypertensive patients are more prone to have significant increases in blood pressure whether they have been treated before hand or not. Transitory hypertension and tachycardia are probably of no consequence in healthy individuals but either or both may be hazardous to those with hypertension, myocardial insufficiency or cerebrovascular diseases. These hemodyamic changes in such individuals may predispose to development of pulmonary oedema,[5] myocardial insufficiency[6] and cerebrovascular accident.[7] At least in such individuals there is a necessity to blunt these harmful hemodyamic effects.

Many pharmacological methods have been devised to reduce the extent of hemodynamic events including high dose of opioids local anesthetics like lignocaine, alpha and beta adrenergic blockers and calcium channel blockers[1] vasodilatation drugs like nitro glycerine.[8] Topical anesthesia with lignocaine applied to the larynx and trachea in a variety of ways remains a popular method used alone or in combination with other techniques.

Intravenous $MgSO_4$ is a popular method of blunting this response, because of its ability to depress sympathoadrenal response and catacholamine release.

Hence the present study was undertaken to compare the effect of Intravenous $MgSO_4$ and intravenous normal saline as a placebo on blunting the haemodynamic responses to endotracheal intubation.

MATERIAL AND METHODS

A study entitled a comparative clinical study of attenuation of cardiovascular responses to laryngoscopy and intubation, employing $MgSO_4$ vs Normal Saline was undertaken in MNR Medical College and Hospital, Sangareddy, during the January 2012 to June 2012. The study was undertaken after obtaining ethical committee clearance as well as informed consent from all the patients.

The study population was divided into two (2) sub groups with 30 patients in each group.

1. Control Group – Received normal saline as a placebo and served as control (n<30).
2. Study Group – Received 50 mg/kg of $MgSO_4$ i.v. 3 MIN before induction of anesthesia (n < 30).

Inclusion Criteria include patients belonging to ASA grades I and II and aged between 18 to 60 years undergoing various surgical procedure under general anesthesia. Pre-anesthetic evaluation and investigations was done on the evening before

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surgery. All patients were tested for any hypersensitivity reaction to local anesthetics and an informed consent was obtained from all the patients. All the patients included in the study were premedicated with Tab. Alprazolam 0.5 mg and Tab. Ranitidine 150 mg orally at bed time the previous day.

Patients in control group received normal saline and served as control. Patients in study group received Inj. $MgSO_4$ 50 mg/kg i.v. 3 minutes before induction of anesthesia. The intubating anesthetist was blinded to the study and dilutant procedure.

Anesthesia was induced with inj. Thiopentone 5 mg/kg as 2.5% solution and endotracheal intubation was facilitated with succinylcholine 1.5 mg/kg administered one minute prior to laryngoscopy and intubation. The intubating conditions was evaluated and scoring was done according to the four step scale proposed by Goldberg and colleagues[9] by the intubating anesthetist. It was graded as follow, Grade I- Excellent, Grade II- Good, Grade III- Poor, Grade IV- Impossible intubating condition. The patients were intubated using appropriate sized cuffed endotracheal tubes. After confirming bilateral equal air entry, the endotracheal tube was secured.

Anesthesia was maintained using 66% nitrous oxide and 33% of oxygen. After the patients recovered from succinylcholine further neuromuscular blockade was maintained with non-depolarizing muscle relaxants. At the end of the procedure patients were reversed with neostigmine 0.05 mg/kg IV and glycopyrrolate 0.008 mg/kg IV.

The cardiovascular parameters were recorded in all the patients and cardiovascular parameters were noted as below

1. Pre-operative assessment before giving any study drugs and premedication
2. 30 seconds after intubation
3. 1 minute after intubation
4. 3 minute after intubation
5. 5 minute after intubation

The results were statistically evaluated using student 't' test and ANOVA test comparing between the groups and within the group respectively. P<0.05 was considered statistically significant.

RESULTS

It is a prospective, controlled, randomized, double blind study to evaluate the efficacy of intravenous $MgSO_4$ 50 mg/kg and intravenous normal saline as a placebo on hemodynamic responses to laryngoscopy and endotracheal intubation. Statistically there was no significant difference in two groups regarding the age (p>0.39), sex (p>1.00) and weight (p>0.33) (Table 1 and 2).

Regarding changes in Heart Rate in study group

The basal HR was 89.16±10.65 bpm, 1 minute after intubation, it was 97.20±18.82. Subsequently, the elevated heart rate started settling down. By 3 minutes it was 96.60±18.11bpm and by 5 minutes it was 91.40±14.67 bpm. The increase in the HR at 1 minute after intubation compared to basal value was statistically highly significant (p < 0.01) (Table 3).

Changes in Systolic Blood Pressure in study group

The basal value of SBP was 127.86±10.27 mm Hg, 1 minute following intubation the SBP was 122.40±15.32 mm Hg,. Afterwards the elevated blood pressure started coming down towards the baseline value. By 3 minutes it was 119.50±10.90 mm Hg and by 5 minutes it was 117.53±9.34 mm Hg. The decrease in SBP observed at 1 minute and 3 min after intubation when compared with basal value was statistically significant (p < 0.001) and (p<0.001) respectively (Table 3).

Changes in Rate Pressure Product in study group

The basal RPP was 113.93±164.44. One minute after intubation, the RPP increased to 119.33±328.51. Subsequently the elevated RPP started settling down. By 3 minutes, it was 116.96±27.78 and by 5 minutes it was 107.20±185.24. The decrease in RPP 1minute and 3 minute after intubation when compared with the basal value was statistically significant (p <0.001) and (p<0.01) respectively (Table 3).

DISCUSSION

Laryngoscopy and endotracheal intubation are associated with significant hypertension, tachycardia and arrhythmias. These hemodynamic responses were first recognized as early as in 1940 by Reid and Bruce et al.[1] They postulated that the disturbances in cardiovascular system were reflex in nature and

Parameter	Group	N	Mean ± SD	P value
AGE (years)	Group 1	30	35.0667±12.1199	0.39001
	Group 2	30	37.7333±11.7266	
Weight (kg)	Group 1	30	60.8667±7.9989	0.33939
	Group 2	30	63.1667±10.3460	

Table-1: Frequency Distribution of Cases According To Age and Weight

Group 1		Group 2	
Male	Female	Male	Female
18 (60%)	12 (40%)	18 (60%)	12(40%)

Table-2: Distribution of case according to Gender

Time	Group 1	Group 2
Mean Heart Rate		
Pre-operative	81.86±11.5	89.16±10.65
Intubation-30 sec	89.66±9.33	95.66±17.71
1 min	107.53±12.20	97.20±18.82
3 min	99.93±11.95	96.60±18.11
5 min	93.66±11.82	91.40±14.67
Mean Systolic Blood Pressure		
Pre-operative	122.66±11.72	127.86±10.27
Intubation- 30 sec	121.06±11.43	118.46±11.10
1 min	155.80±19.36	122.40±15.32
The Mean Rate Pressure Product (RPP)		
Pre-operative	100.00±192.8	113.93±164.4
Intubation- 30 sec	108.26±161.30	113.30±271.6
1 min	168.26±326.52	119.33±321.5
3 min	134.33±254.43	11646.96±127.78
5 min	115.00±197.82	107.20±185.24

Table-3: Showing Changes In Mean Heart Rate, Mean Systolic BP And Mean Rate Pressure Product mediated by the vagus nerve. In 1950 Burstein et al [2] studied the effects of laryngoscopy and tracheal intubation on ECG changes and suggested the pressor response as consequences of an increase in sympathetic and sympathoadrenal activity.

These responses are transitory, variable and unpredictable and are much more pronounced in hypertensive patients than in normotensive individuals.[4] This hemodynamic stimulus is associated with increase in plasma nor-adrenaline concentrations parallel with the increase in blood pressure.[3,9]

Michael F. M. et al[14] did a study to evaluate the effects of pretreatment with 60 mg/kg body weight magnesium sulfate intravenous on cardiovascular responses and catecholamine release associated with tracheal intubation were measured in 15 normal patients and in 15 saline solution pre-treated controls. Magnesium pre-treatment increased heart rate by 13 ± 3.9 beats/minute. After intubation, heart rate was unchanged in the magnesium group at 107.3 ± 3.6 beats/minute but increased in the control group to 120.9 ± 4.6 beats/minute ($P<0.05$). Systolic blood pressure increased after intubation from 106.8 ± 3.1 to 121.0 ± 4.4 mm Hg in patients given magnesium and from 106.4 ± 3.12 to 145.1 ± 5.6 mm Hg in the control group ($P<0.05$). It was concluded that magnesium sulfate attenuates the catecholamine mediated responses after tracheal intubation.

In our study, we found that SBP falls significantly after 1 minute ($p<0.001$) and 3 minutes ($p<0.001$) of intubation with decreased RPP after 1 minute ($p<0.001$) and 3 minutes ($p<0.01$) respectively in the study group. But at the same time, it is associated with considerable rise in the HR($p< 0.01$) compared to the control group, thus showing similar results with the study.

Another study done by Yap LC[11] et al (1994) to evaluate the effect of magnesium sulfate on heart rate, blood pressure and hyperkalemic response following succinylcholine injection during tracheal intubation, using 60 mg/kg of magnesium sulfate intravenously 1min before succinylcholine injection. The control group received an equal volume of normal saline in the same way. Heart rate, blood pressure, venous and arterial potassium levels were measured at 1, 3, 5 and 10 minutes after intubation.

The results showed that magnesium sulfate could attenuate the hypertensive response at 1 minute and the hyperkalemic response at 1 and 3 minutes following succinylcholine-facilitated intubation; the tachycardia response at 1 minute after intubation could not be reduced by this agent.

The efficacy of intravenous magnesium to block the effects of sympathetic stimulation after nasotracheal intubation was studied by Jain PN et al (1995).[12] They observed that IV magnesium sulphate in a dose of 60 mg/kg body wt. significantly ($p<0.05$) attenuated the hemodynamic response to nasotracheal intubation without producing a significant rise in serum magnesium levels. This study also got the same results of hemodynamic attenuation with iv magnesium sulfate, but associated with some amount of tachycardia after 1 min of intubation.

In our study, magnesium sulfate causes increase in HR significantly after 1 min of intubation with significant reduction in SBP and RPP. After 3 min of intubation, further fall in SBP and RPP occurred, thus showing consistency with the study.[13] However, we did not find any prolongation of neuromuscular blockade.

The hemodynamic variables were recorded in a study by G. D Puri et al[14] before induction, after the trial drug, after induction, and after endotracheal intubation. Magnesium sulfate administration was associated with increased cardiac index, a minimal increase in heart rate, and a significant decrease in mean arterial pressure (MAP) and systemic vascular resistance (SVR).

The magnesium group patients had a significantly lesser increase in MAP and SVR compared with control patients who received lidocaine before endotracheal intubation. Thus, magnesium is a useful adjuvant to attenuate endotracheal intubation response in patients with CAD.

However, in our study, we found that SBP falls significantly after 1 minute and 3 minutes of intubation with decreased RPP after 1 minute and 3 minutes respectively in the study group. But at the same time, it is associated with considerable rise in the HR compared to controls. Due to rise in HR, magnesium sulfate should be used with caution used for patients having coronary insufficiency or CAD.

In a randomized trail done by KH Naghibi et al.,[15] (2000) comparing the effects of magnesium sulphate with lidocaine for attenuating of presser response to tracheal intubations in 120 patients undergoing general anesthesia for cataract surgery. They have studied the effect of pretreatment with magnesium sulphate 50 mg/kg or 1.5 mg/kg lidocaine on this presser response found that there were no significant differences between two groups with respect preinduction of heart rate, mean arterial pressure, sex and age. A combined analysis showed that the magnesium sulphate were significantly better than 1.5mg/kg lidocaine in attenuating presser response to tracheal intubation, preventing postoperative tachycardia and hypertension and it is better than lidocaine.

Magnesium sulfate infusion in this study is effective in preventing increase in SBP and RPP after intubation but not effective in decreasing the heart rate. It was associated with tachycardia which come down to pre-operative level after 5 min of intubation.

Pipelzadeh MR et al[16] (2001) concluded that magnesium sulfate had a very limited usefulness in the attenuation of blood pressure and heart rate in young healthy patients if given during induction of anesthesia. However, in this study, they had used magnesium sulfate in dose of 50 mg/ kg body wt. just before laryngoscopy and found marked decrease in SBP and RPP after 1 and 3 minutes of intubation respectively.

Lim SH[17] et al (2007) studied the effects of magnesium sulfate and remifentanil at attenuating the sympathetic responses were compared during laryngoscopy and endotracheal intubation.

Whether i.v. magnesium sulphate attenuates the haemodynamic stress responses to pneumoperitoneum by changing neurohumoral responses during laparoscopic cholecystectomy was studied by D. Jee et al[18] (2009), found that systolic and diastolic arterial pressures were greater in the control group ($P<0.05$) than in the magnesium group post-pneumoperitoneum, concluded that I.V. magnesium sulphate before pneumoperitoneum attenuates arterial pressure increases during laparoscopic cholecystectomy. This attenuation is apparently related to reductions in the release of catecholamine, vasopressin, or both.

In our study, we have found attenuation of SBP and RPP after intubation in magnesium sulfate group with slight increase in heart rate. This can be explained due to inherent property of drug in causing decreased catacholamine release[9] with vasodilatation thereby causing reduction in SBP and increase in heart rate.

CONCLUSION

We conclude that Magnesium sulphate 50 mg/kg IV infusion 3 minutes before induction, is a simple, effective and practical method of blunting cardiovascular responses to tracheal intubation, not associated with any adverse effect.

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