ORIGINAL RESEARCH PAPER
Volume - 11 | Issue - 05 | May - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFECT OF INTRAVENOUS MAGNESIUM SULPHATE AND LIDOCAINE ON HEMODYNAMIC RESPONSE TO LARYNGOSCOPY AND ENDOTRACHEAL INTUBATION

Anaesthesiology

Ashmita Paudel* MD Anaesthesia and Critical Care Bakullahar Hospital :E - W Hwy, Ratnanagar 44204. *Corresponding Author

Rajesh Kumar Yadav MD Anaesthesia and Critical Care College of medical sciences ,Bharatpur 10, 44204.

Ajay Singh Thapa MD Anaesthesia and Critical Care College of medical sciences, Bharatpur 10, 44204.

Noor Alam MD Anaesthesia and Critical Care College of medical sciences, Bharatpur 10, 44204.

Anima Pradhan MD Anaesthesia and Critical Care College of medical sciences, Bharatpur 10, 44204.

Sangam Pokhrel MD Anaesthesia and Critical Care College of medical sciences ,Bharatpur 10, 44204.

ABSTRACT

Introduction: Laryngoscopy and endotracheal intubation is associated with sympathetic stimulation leading to increase in heart rate and blood pressure. We have compared the efficacy of Magnesium sulphate and Lidocaine in blunting the hemodynamic response to laryngoscopy and tracheal intubation as well as the side effects of the drugs.

Materials and methods: We conducted a double blinded, prospective, randomized study performed on total of 80, ASA I and II patients who were divided into group M, receiving 30mg/kg Magnesium sulphate, and group L receiving 1.5mg/kg Lidocaine, before laryngoscopy and intubation. Changes in hemodynamic variables like Heart rate(HR), Systolic blood pressure(SBP), Diastolic blood pressure(DBP), and Mean arterial pressure (MAP) were recorded at various time intervals such as at pre anesthetic baseline, before induction, 1min, 3 min, 5 min, and 10 min post intubation. Patients were also observed for adverse effects of the drugs used.

Results: Demographic parameters were comparable in terms of age, weight, ASA, distribution of gender. Baseline HR, SBP, DBP, and MAP were similar and insignificant (p-value>0.05) when the two groups were compared. There was significant rise in HR in Lidocaine group as compared to Magnesium group at 1min,3min post-intubation(p-value<0.05). Significant attenuation of BP was seen with Magnesium as compared to Lidocaine at 1min, 3min, 5min post-intubation(p-value<0.05).No adverse effects of drugs were observed during the study.

Conclusion: Though Lidocaine and Magnesium both attenuated the hemodynamic response to laryngoscopy and intubation, Magnesium was found to control hemodynamic changes better than Lidocaine. And at the dosage of drugs we used there were no adverse effects.

KEYWORDS

Blood pressure, Heart rate, Intubation, Laryngoscopy, Lidocaine, Magnesium sulphate.

INTRODUCTION

endotracheal intubation is a standard procedure to secure airway and provide ventilation adequately to patients under general anesthesia [1]. Hemodynamic disturbances associated with these procedure may manifest as tachycardia, hypertension, and dysrhythmias due to release of catecholamines [5].

Hemodynamic response to laryngoscopy and intubation was described around 70 yrs back by Reid LC and Brace DE et al for the first time[7]. In ASA I patients, laryngoscopy and intubation leads to an average increase in blood pressure of 40 to 50%, and a 20% increase in heart rate, which are greatest at one minute after intubation and lasts for 5 to 10 minute.[7] This hemodynamic alteration may predispose susceptible patient to myocardial infarction, pulmonary edema, cerebrovascular accidents and hence need to be controlled adequately.[9] Several non-pharmacological and pharmacological modalities have been advocated to blunt stress response during laryngoscopy and intubation. Many methods have been identified to attenuate these responses including topical anesthesia of oropharynx, laryngotracheal instillation of lidocaine before intubation, intravenous lidocaine, deep inhalational anesthesia, narcotics, vasodilators, intravenous magnesium sulphate, adrenergic and calcium blockers even though these techniques have drawbacks [14-21]. Magnesium sulfate is a bivalent salt that produces vasodilatation and causes a drop in blood pressure by diminishing sympathetic excitability of muscle cells [6]. It has been approved as a medication for treatment of preeclampsia and blood pressure management. Due to its inhibiting effects on release of catecholamines from adrenergic nerve endings and adrenal medulla, magnesium has been an option for minimizing adverse cardiovascular responses during laryngoscopy and intubation [23]. It has been approved as a medication for treatment of preeclampsia and blood pressure management. Its positive effects on ischemic infectious endocarditis and for management of hemodynamic variables in patients with heart disease are being gradually recognized[7-10].

Therefore this study aimed to compare the effect of intravenous lidocaine and magnesium sulphate on the attenuation of cardiovascular responses after laryngoscopy and endotracheal intubation in elective surgical patients.

MATERIALS AND METHODS

OBJECTIVES

General Objective

To compare the effects of Magnesium Sulphate and Lidocaine in attenuating the hemodynamic responses to laryngoscopy and endotracheal intubation.

Specific Objectives

- To compare the change in heart rate between two groups.
- To compare the change in arterial blood pressure (SBP, DBP, MAP) between two groups.
- To see the incidence of side effects of study drugs; Magnesium:- vomiting, hypotension, bradycardia; Lidocaine:- shivering, drug allergy

MATERIALS AND METHOD

Type of Study

Prospective, randomized, double blind comparative study.

Place of Study

- The study was conducted in Department of Anesthesiology, College of Medical Sciences, Bharatpur.
- Data Collection Date: Dec 2017 to Nov 2018

Randomization and blinding technique

Randomization was done using closed envelope method. A total of 80 envelopes were prepared before start of study. Half of the envelopes contained receipt where Group M was written and the other half contained receipt where Group L was written. These envelopes were mixed and arranged randomly. The accompanying anesthesia assistant was trained regarding protocol of the study and was allowed to open the envelope before induction of anesthesia and provide the drug as per the protocol and code the patient. Attending anesthesiologist did not know the drug being given. Data collection was done by me and decoding was done only during analysis of the collected data.

Each patient in group M received:-

- 30mg/kg Magnesium Sulphate diluted in 100ml NS as infusion

before induction over 5 min.
- 10ml of NS in 10 ml syringe 90 seconds before intubation.

Patients in L group received:-
- 100ml of Normal saline infusion over 5 min prior to induction without Magnesium sulphate.
- 1.5mg/kg Lignocaine which was diluted up to 10ml with NS in 10 ml syringe 90 seconds before intubation

INCLUSION CRITERIA
i. Age group of 18-60 years
ii. American society of Anesthesiologists-Physical status (ASA-PS) grade I and II
iii. Elective surgery requiring general anesthesia with endotracheal intubation

EXCLUSION CRITERIA
I. Patient's refusal.
ii. History of allergy to the study drugs.
iii. Anticipated difficult airway such as Mallampati Grading III or IV or any other anticipated airway difficulty.
iv. Patient on medications like calcium channel blockers, beta blockers or aminoglycosides.
v. Patient already on intravenous magnesium therapy or having hypermagnesemia.
vi. Laryngoscopy and intubation taking more than 30 seconds.

METHODOLOGY
Methods
After approval from the Institutional Review Board of College of Medical Sciences, Bharatpur, 80 ASA physical status I and II patients with age ranging from 18-60 years who were scheduled for elective surgery under general anesthesia with endotracheal tube were included in the study.

The patients in M group received the first drug mentioned above, that is, 30mg/kg Magnesium diluted in 100ml NS over 5 min before induction and the patient in L group received fourth drug, that is, 100ml NS over five minutes before induction.

All patients were pre-oxygenated with 100% oxygen for 3 min. Pre-induction vitals recorded after completion of infusion and then anesthesia was induced with inj. Midazolam 0.04mg/kg, inj. Fentanyl 1.5 mcg/kg and inj. Propofol 2 mg/ kg. 90sec before intubation group M received third drug, 10ml NS in 10ml syringe and group Lidocaine received second drug, preservative free Lidocaine 1.5mg/kg diluted up to 10 ml with NS in a 10 ml syringe. Tracheal intubation with appropriate size ET tube was facilitated with inj. Vecuronium 0.1 mg/ kg. Heart rate, arterial blood pressure(SBP, DBP, MAP) levels were recorded after intubation at 1, 3, 5 and 10 min after intubation.

During these 10 minutes following the intubation all kinds of surgical stimulus was not allowed however painting and draping was allowed. The study duration ended 10 minutes after intubation and the surgery continued further. Vital parameters were recorded throughout the surgical procedure. Patients were observed for complications like hypotension, hypertension, arrhythmias, hypoxemia, shivering, and treated as required. After extubation patients were transferred to the post-anesthesia care unit and monitored for signs of any drug induced effects such as nausea, vomiting, any respiratory inadequacy or hemodynamic instability in form of hypotension/ hypertension or tachycardia/bradycardia.

Statistical method employed
- Both the group (Group 1 and group 2) were compared in respect to hemodynamic parameters HR, SBP, DBP, MBP.
- Statistical analysis was done using statistical software SPSS version 21.
- Descriptive statistics (to measure mean, standard deviation).
- Independent sample T test (to measure differessnce between two groups).
- Contingency table analysis (for association between rows and columns).
- $p < 0.05$ was considered significant and $p < 0.01$ was considered highly significant.

RESULTS
Demographic comparisons

Table 1 : Age distribution of patients

Group	Mean	Std. Deviation	p value
Magnesium sulphate	42.5	±8.5	
Lidocaine	43.18	±9.11	0.905[ns]
Total	45.85	±8.77	

Ns Non significant

Mean age of the patients in Magnesium group was 42.5years with standard deviation of ± 8.5 years. In Lidocaine group, the mean age was 43.18years with standard deviation of ± 9.11years. There was no statistically significant difference between the ages in both the groups (P = 0. 905).

Table 2: Gender distribution of patient studied

Gender	Magnesium sulphate		Lignocaine	
	Number	%	Number	%
Male	19	47.5	23	57.5
Female	21	52.5	17	42.5
Total	40	100	40	100
p value: 0.37				

Gender distribution in between the two groups were similar, Magnesium group had 47.5% males (n=19) and 52.5% female (n=21) and Lidocaine group had 57.5% males (n=23) and 42.5% female (n=17). Statistical analysis revealed that gender differences in the two groups were comparable (p value 0.37).

Table 3- Weight distribution of patients

Magnesium sulphate	61.006.07	0.528 (Not significant)
Lidocaine	61.677.33	
Total	61.346.70	

In Magnesium group, the mean weight was 61 with a standard deviation of ± 6.07. The minimum weight was 52 and the maximum weight was 70 kg. In lidocaine group, the mean weight was 61.67 with a standard deviation of ± 7.33. The minimum weight was 50 and the maximum weight was 82. There was no statistically significant difference in mean weight between the two groups. (P=0.528)

Table 4 - ASA grade in two group of patient studied

ASA grade	Magnesium sulphate		Lidocaine	
	Number	%	Number	%
Grade I	23	57.5	20	50
Grade II	17	42.5	20	50
Total	40	100	40	100
p value: 0.501				

ASA grade of the studied population between the two groups were similar. Magnesium Group had 23 patients with ASA grade I and 17 patients with ASA grade II whereas Lidocaine Group had 20 patients with ASA grade I and 20 patients with ASA grade II. ASA grade in between the groups were comparable (p> 0. 5).

Table 5: Comparison of Heart rate (bpm) between the two groups

Time interval	Magnesium sulphate	Lidocaine	Pvalue
Baseline	87.53±8.97	87.5±8.75	0.85
Before induction	86.58±7.18	88.8±5.55	0.125
1 min after intubation	89.50±6.34	93.43±6.80	0.021
3 min after intubation	87.65±7.76	92.58±7.21	0.04
5 min after intubation	85.74±5.33	89.15±8.30	0.032
10 min after intubation	85.43±8.23	88.73±8.97	0.90

($p < 0.01$)* – Statistically highly significant, ($p < 0.05$) – Statistically significant,
($p > 0.05$) – Statistically not significant (NS)

Baseline mean heart rate were comparable in both groups. Heart rate before induction and 10min was statistically insignificant in between the groups(p>0.05).But, the heart rate was significantly increased in Lidocaine group 1min,3min and 5min post intubation when compared to group M ($p < 0.05$).

Table 6: Comparison of mean SBP changes

Time interval	Magnesium sulphate	Lidocaine	P value
Baseline	129.90± 14.81	128.83±12.20	0.72
Before induction	125.60 ±11.16	127.03±7.05	0.49

1 min after intubation	126.50±5.543	132.48±10.54	0.02
3 min after intubation	122.93±7.58	136.10±9.65	0.001
5 min after intubation	123.58±5.70	130.60±9.655	0.004
10 min after intubation	123.73±8.18	129.43±10.18	0.07

($p < 0.01$)* – Statistically highly significant, ($p < 0.05$) – Statistically significant,

($p > 0.05$) – Statistically not significant (NS)

Baseline mean SBP was comparable in both groups. The change in mean SBP before induction and after 10min of intubation in the two groups were statistically not significant ($p>0.05$). The change in mean SBP in Lidocaine group raised at 1min,3min,5min as compared to Magnesium group and was significant ($p<0.05$). However, the change in mean SBP was highly significant at 3min, at 5min after intubation ($p<0.01$).

Table 7: Comparison of mean DBP (mmHg) changes

Time interval	Magnesium sulphate	Lidocaine	p value
Baseline	78.10±10.01	76.95±9.51	0.63
Before induction	71.63±6.70	73.23±6.02	0.12
1 min after intubation	76.08±6.05	80.60±7.04	0.03
3 min after intubation	66.25±5.65	79.65±10.04	0.002
5 min after intubation	70.83±7.26	78.05±6.16	0.005
10 min after intubation	75.18±7.34	78.28±6.48	0.49

($p < 0.01$)* – Statistically highly significant, ($p < 0.05$) – Statistically significant,
($p > 0.05$) – Statistically not significant (NS)

Mean DBP were comparable in both group at baseline. The changes in mean DBP before induction and at 10 min post intubation were statistically not significant ($p>0.05$) as compared to each other's. However, the mean DBP in the Magnesium group at 1min, 3 min, 5 min were significantly attenuated as compared to Lidocaine group($p<0.05$).

Table 8: Comparison of mean MAP (bpm) changes between two groups.

Time interval	Magnesium sulphate	Lidocaine	p value
Baseline	95.23 ± 8.17	94.20±7.75	0.56
Before induction	89.63±6.11	91.15±4.40	0.20
1 min after intubation	92.63±7.22	97.15±5.50	0.02
3 min after intubation	87.38±5.177	95.55±7.11	0.003
5 min after intubation	89.65±7.11	95.55±5.62	0.004
10 min after intubation	90.90±6.21	95.35±4.91	0.01

($p < 0.01$) – Statistically highly significant, ($p < 0.05$) – Statistically significant,
($p > 0.05$) – Statistically not significant (NS)

The baseline mean MAP value in both the groups was comparable ($p>0.05$). The changes in mean MAP before induction were also statistically not significant ($p>0.05$). However, the mean MAP in the Magnesium group at 1min, 3 min, 5 min and 10min after intubation were significantly attenuated ($p < 0.05$) as compared to Lidocaine group.

DISCUSSION

The present study demonstrated better attenuation of the hemodynamic response to laryngoscopy and intubation with injection Magnesium sulphate at a dose of 30mg/kg as compared to injection Lidocaine 1.5mg/kg. The elevation of heart rate and blood pressure are transient, variable and unpredictable. These changes, however, are well tolerated by healthy individuals. But, such changes are deleterious in patients with severe hypertension, coronary artery disease or myocardial insufficiency.[9] Many pharmacological modalities have been used to prevent this intubation response, like adrenergic receptor blockers such as dexmedetomidine, clonidine, beta-blockers, local anesthetic such as lidocaine (nebulized or intravenous or gargling), calcium channel blocker, vasodilators like sodium nitroprusside, nitroglycerine and even intravenous opioids.[14-21] Similarly, many of the researchers have used Magnesium sulphate in blunting the intubation reflexes and have shown promising outcomes.

In our study, the mean age, sex, weight distribution in between the Magnesium and the Lidocaine group were comparable ($p>0.05$). Baseline and pre-induction mean HR, mean SBP, mean DBP, mean MAP were also statistically insignificant when compared in between these groups ($p>0.05$).

In both groups, there was increase in heart rate from the pre-induction values after intubation. But when compared to the Magnesium group , there was a significant increase in heart rate in the Lidocaine group at 1min, 3min, 5min post-intubation($p<0.05$). Heart rate in the Magnesium group returned to baseline within 5 min whereas it persistently remained elevated in the Lidocaine group till 10 min post intubation. In the Magnesium group there was better attenuation of heart rate as compared to Lidocaine post-intubation. This greater efficacy of Magnesium in attenuating heart rate response as compared to Lidocaine could be due to its ability to inhibit release of catecholamines.[5]

James et al.[5] in 1988 studied the effects of pre-treatment with 60 mg/kg intravenous Magnesium sulphate on cardiovascular responses and catecholamine release associated with tracheal intubation in 30 patients.HR increased from baseline in the patients of magnesium group after administration of the drug but before intubation ($p<0.05$). However, there was not much increment in HR after intubation. When they compared the Magnesium group with the Control group(NS), significant increase in heart rate was found in the Control group immediately after intubation and after 2mins ($p<0.05$). BP increased significantly in the Control group as compared to the Magnesium group just after intubation, at 2min and 5min post-intubation. Thus, they concluded Magnesium pretreatment controls the hemodynamic response to laryngoscopy and intubation. This conclusion is in accordance with our study .However the initial increase in HR seen with administration of Magnesium in their study was not seen in our study and this may be due to administration of sodium thiopentone in their study which causes reflex tachycardia as well as the ability of Magnesium sulphate in high dose used by them to predominantly inhibit the release of acetylcholine from the vagal nerve .[29]

Similarly, Kotwani et al.[25] in 2016 compared two doses of Magnesium sulphate (30mg/kg and 40mg/kg) with control group(NS) in attenuating hemodynamic responses to laryngoscopy and intubation. Attenuation of mean SBP and HR was seen with both the Magnesium doses as compared to the Control, after intubation ($p<0.05$). Thus, the conclusion that was made in favor of Magnesium is in accordance with our study.

Other studies were done by Hossain et al.[23] in 2009, Padmawar et al.[22] in 2016 using Magnesium sulphate 50mg/kg and 40 mg/kg respectively comparing with Lidocaine 1.5mg/kg. Attenuation of HR, SBP, DBP and MAP was found significant in Magnesium as compared to the Lignocaine group at 1min,3min and 5min post-intubation($p<0.05$). This was further supported by study done by Vallabha R and Muthayala VK[21] in 2018 where significant attenuation of MAP and HR was seen with Magnesium sulphate at a dose of 30 mg/kg as compared to Lignocaine 1.5mg/kg at 1 min, 3min, 5min post-intubation ($p<0.05$). They did not observe any adverse effect of the studied drugs. These studies are in accordance with our study.

Likewise, Bandey et al.[24] in 2016 compared between Magnesium sulphate (30mg/kg), Lidocaine (1.5mg/kg) and Control (NS). Attenuation of mean SBP, mean DBP, mean MAP was better with Magnesium among all the groups at 1 min, 3min, and 5min post-intubation. There was increase in mean HR in Magnesium group from baseline value but was comparable with lidocaine all the time .The attenuation of HR was significant in Magnesium as well as Lidocaine group when compared to the control. In our study attenuation of BP as well as HR was better with Magnesium. This difference regarding the HR may be due to difference in rate of administration of Magnesium.

Similarly Nooraei et al.[26] in 2012 also observed better attenuation of mean SBP and mean MAP with Magnesium sulphate(60mg/kg) as compared to the Lidocaine(1.5mg/kg) 1min, 2min post-intubation ($p<0.05$).Mean DBP was comparable in both group all the time post-intubation($p>0.05$). Attenuation of HR 1min after intubation was comparable among the groups ($p>0.05$ but better controlled with Lignocaine compared to Magnesium at 2min and 3min post intubation. Thus they concluded Magnesium attenuates hemodynamic response better than Lidocaine but with tendency to increase HR. In our study we found better attenuation of BP as well as HR with Magnesium as compared to Lidocaine at 1min, 3min, and 5min post-intubation. The

increase in HR with Magnesium as compared to lidocaine seen in their study may be due to use of high dose of Magnesium sulphate.[28]

Kiaee et al.[27] in 2013 compared the effect of intravenous Magnesium sulphate (50mg/kg) and Lidocaine(1.5mg/kg) in hemodynamic responses to endotracheal intubation in Elective Coronary Artery Bypass Grafting. There was more than 20% decrease in mean HR, mean SBP, mean DBP and mean MAP in the Lidocaine group however the change in variables were less than 10% in Magnesium group. So they concluded hemodynamics is better maintained with Magnesium than Lidocaine . In our study hemodynamics was maintained with both the drugs (all parameters were within 20% of baseline) but better maintained with Magnesium as compared to Lidocaine.

CONCLUSION

This is a prospective, double blind and randomized study done to compare the effects of Magnesium sulphate and Lidocaine in attenuating hemodynamic response during laryngoscopy and endotracheal intubation. We found that Magnesium sulphate given before induction of anesthesia was effective in attenuating hemodynamic responses during laryngoscopy and endotracheal intubation significantly as compared to Lidocaine. But based on this study prophylaxis of magnesium sulphate is associated with a more favorable hemodynamic response. We recommend prophylactic IV magnesium sulphate to consider for attenuating hemodynamic response to laryngoscopy and endotracheal intubation.

LIMITATIONS

1. This study was done in ASA PS I and II group of patients and in those without significant cardiovascular diseases, so the result of this study may or may not correlate with the patients of higher grades of ASA PS and those with cardiovascular diseases in whom control of hemodynamic responses to laryngoscopy and endotracheal intubation is of increased importance.
2. The plasma level of stress hormones were not measured.
3. Effect of Magnesium on prolongation of duration of NMB was not observed.

The Researchers' Level of the Participation

All authers fully and actively participated in this study and manuscripts writing.

Source of funding: self – funding
Conflict of interest: none

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