COMPARISON OF THE EFFECTIVENESS OF MGSO4 30 MG/KGBW AND INTRAVENOUS LIDOCAINE 1.5 MG/KGBW TO PREVENT POST-INTUBATION HEMODYNAMICS FLUCTUATION

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ABSTRACT

Background: Intubation can cause hemodynamic fluctuations such as increases of systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate. MgSO4 and lidocaine can be used as premedication drugs to reduce the hemodynamic response to intubation.

Objective: To compare the efficacy of intravenous MgSO4 30 mg/kgBW with lidocaine 1.5 mg/kgBW to prevent hemodynamic fluctuations after endotracheal intubation.

Methods: This double-blind randomized controlled trial was conducted in 52 patients meeting the inclusion criteria who underwent surgery with general anesthesia using an endotracheal tube. These subjects were grouped into group A receiving intravenous MgSO4 30 mg/kgBW treatment and group B receiving intravenous lidocaine 1.5 mg/kgBW treatment. Hemodynamic fluctuation was recorded 1 minute after intubation.

Results: Subjects receiving MgSO4 had lower increments of SBP ($p \leq 0.001$), DBP ($p=0.001$), MAP ($p \leq 0.001$), and HR ($p=0.001$) than those of receiving lidocaine.

Conclusion: Intravenous MgSO4 30 mg/kgBW is more effective than intravenous lidocaine 1.5 mg/kgBW in preventing hemodynamic fluctuations after endotracheal intubation

Keywords: Intubation, MgSO4, lidocaine, systolic and diastolic blood pressure, arterial pressure, and heart rate.

INTRODUCTION

Laryngoscopy and intubation can cause stress responses in significant spectrums. The stress response in patients receiving general anesthesia can be seen as a phenomenon that may be associated with the endocrine or autonomic system disorders (Butterworth, 2013).

It is thought that stretching of the larynx and pharynx tissue during laryngoscopy and intubation is the leading cause of hemodynamic response due to catecholamine secretion and cardiac vagal reflexes' inhibition in the presence of symptoms of tachycardia, hypertension, dysrhythmia as well as disorders of the respiratory and neurological systems (Smith 2008; Teong 2020). These hemodynamic changes usually begin within 5 seconds after laryngoscopy, and their peak occurs one minute after the start of intubation and lasts for 5-10 minutes. This condition can lead to a serious problem in high risk patients (Teong 2020; Sakilar 2015).

In order to overcome cardiovascular response during laryngoscopy and intubation, we can use deep anesthesia technique or provide local anesthetic drugs, opioids (fentanyl, alfentanil), beta-adrenergic blockers, vasodilators (nitroglycerin, sodium nitroprusside), calcium channel blockers (diltiazem), alpha-2-adrenergic agonists (chlorine, dexmedetomidine) and magnesium sulfate (Teong 2020; Ongewe 2019; Goarya 2014; Kumar 2016).

Administering lidocaine is one of the common ways to reduce cardiovascular fluctuation. Lidocaine, when administered systemically, will have antagonist effect on sodium channel and N-Methyl-D-Aspartate (NMDA) receptor, reduce the release of substance P, and have a glycinergic action which can decrease reactivity in the airway (Mendonca 2017; Kurabe 2016).

Intravenous lidocaine administration at a dose of 1.5 mg/kgBW administered 3 minutes before laryngoscopy and intubation can produce optimal hemodynamics (Mendonca, 2017). Magnesium sulfate ($MgSO_4$) can be used as an alternative medicine to prevent post-intubation hemodynamic shock. Administering $MgSO_4$ before endotracheal intubation effectively reduces the increase in blood pressure and heart rate (Goarya 2014; Mendonca, 2017). $MgSO_4$ has been shown to have antinociceptive mainly due to its antagonistic effect on NMDA receptors as well as calcium ions and inhibits the release of catecholamines from adrenergic terminal nerves and adrenal medulla (Goarya 2014; Kothari 2008).

Considering the severity of complications that can occur due to uncontrolled hemodynamic responses, especially in patients with comorbid diseases, anesthesiologists need to know the most appropriate and effective premedication interventions for patients' hemodynamic response endotracheal intubation. On that account we conducted this study to compare $MgSO_4$ 30 mg/kgBW with lidocaine 1.5 mg/kgBW which are given intravenously as premedication to prevent hemodynamic fluctuation after endotracheal intubation.

METHODS

We conducted a double-blind randomized clinical trial study in subjects undergoing elective surgery using general anesthesia with endotracheal intubation from October to November 2020 at the Central Surgical Installation of Dr. Moewardi Surakarta Hospital.

We used software Open Source Epidemiologic Statistics for Public Health, Version 3.0, with the formula of Sample Size for Comparing Two Means to estimate the sample size. The number of samples required were 52 subjects. These subjects were randomly assigned into two groups, lidocaine and $MgSO_4$ groups. Patients aged 18-65 year old with no allergy to either lidocaine or $MgSO_4$, who underwent general anesthesia with the duration of surgery less than three hours were included in this study. While the exclusion criteria were patients with difficult intubation predictions, cardiovascular disorders, cerebrovascular disorders, a history of respiratory distress, and impaired renal as well as liver functions. Lastly, the drop-out criteria were cardiac and pulmonary emergencies during surgery, intubation difficulties, more than twice intubations, and hypersensitivity reactions to $MgSO_4$ and lidocaine.

Intravenous magnesium sulfate 30 mg/kg was administered 3 mins before induction, while IV lignocaine 1.5 mg/kg was administered 1 min before induction. We used propofol 1.5 mg/kg and rocuronium 1.2 mg/kg for the induction. Direct laryngoscopy and endotracheal intubation used oral ETT size of 7.0 for female and 7.5 for male. They were performed 90 s after induction. Furthermore, cuff developed with air in a syringe 20 ml until cuff pressure of 30 mmhg. Anesthesia was maintained with sevoflurane 1 MAC in O_2 and N_2O 50%. The noninvasive arterial pressure and HR was recorded using Bedside Monitor before the study drugs were given and in the first minute after intubation.

The data obtained were analyzed with the SPSS *version 23.0 for Windows* program. The normality test used the *Shapiro-wilk* test because the sample size of each group was less than 50. Unpaired T-test was used for normal distribution data.

RESULTS

Fifty-two patients met the inclusion criteria of the study. There were no significant differences regarding baseline demographic characteristics of the study subjects in groups L and M (**Table 1**).

Table 1 Demographic characteristics of the study subjects

Characteristics	Drug		p-value
	Lidocaine (n=26)	MgSO4 (n=26)	
Gender			
Male	9 (34.6%)	9 (34.6%)	
Female	17 (65.4%)	17 (65.4%)	
Age	45.77 $\pm$12.75	40.58 $\pm$11.96	0.136
BMI	21.73 $\pm$2.34	21.58 $\pm$1.58	0.788
ASA			
I	0 (0.0%)	0 (0.0%)	
II	26 (100.0%)	26 (100.0%)	

Table 2 The increments of SBP, DBP, MAP, and HR of Lidocaine and $MgSO_4$

Variable	Drug		pvalue
	Lidocaine (n=26)	MgSO4 (n=26)	
Increment Systolic blood pressure (%)	7.76 $\pm$2.93	3.95 $\pm$2.66	<0.001
Increment Diastolic blood pressure (%)	9.93 $\pm$3.61	5.88 $\pm$3.85	0.001
Increment MAP (%)	10.94 $\pm$3.69	4.74 $\pm$2.71	<0.001
Increment Heart rate (%)	10.07 $\pm$4.80	7.49 $\pm$1.63	0.001

Statistically there were significant differences in SBP, DBP, MAP, and HR between L and M groups, with p values of <0.001, 0.001, <0.001, and 0.001, respectively. Higher increments of SBP, DBP, MAP, and HR were observed in L group than those of in M group (**Table 2**).

DISCUSSION

In this study we tried to analyze the hemodynamic response differences between patients receiving $MgSO_4$ 30 mg/kgBW and those with lidocaine 1.5 mg/kgBW given intravenously as premedication in endotracheal intubation.

This study showed that both agents $MgSO_4$ 30 mg/kgBW and lidocaine 1.5 mg/kgBW increase hemodynamic response observed by the increases of SBP, DBP, MAP, and HR at the 1st minute post-intubation. These increases were below 20% and statistically significant ($p<0.05$).

This finding is similar to that of in a study conducted by Nooraei et al in 2013. They found subjects in groups $MgSO_4$ and lidocaine had increments in hemodynamic parameters by 20% from baseline. The highest increment was observed at the 1st and 2nd minutes while the lowest was at 5th minute. Nevertheless, when both of them were compared, $MgSO_4$ group had lower hemodynamic volatility. Increased hemodynamic response after intubation occurs due to catecholamine hormone effect appearing after the first 5 seconds post-intubation and reaches its peak after 1-2 minutes post-intubation and lasts for 5-10 minutes. Then hemodynamic response will return to normal as catecholamine hormone decreases (Smith 2008; Nooraei 2013).

Magnesium serves as a competitive Inositol 1,4,5-triphosphate (IP3) gate inhibitor on calcium channels and prevents IP3 bonding with its receptors. Therefore, magnesium is a calcium antagonist at the cellular level of the IP3 channel (Kothari 2008; Do, 2013. Magnesium is thought to play a role in inhibiting NMDA receptor activity so that such receptor activity does not occur (Do, 2013).

This study used lidocaine because it has a mechanism of action through voltage-gated-sodium channel blocks in nerve tissue to affect nerve transmission (Eipe, 2016). The heart muscle's contractility and conduction are also suppressed by local anesthetic drugs, in which the drug's effect arises due to changes in the cell membranes of the heart muscle (sodium channel blockade) and inhibition of the autonomic nervous system (Butterworth 2013; Stoelting 2006). These effects can reduce sympathoadrenal activation resulting in a change in blood pressure response and heart rate (Stoelting, 2006).

Administration of $MgSO_4$ 30 mg/ kgBW intravenously successfully controlled hemodynamic changes during laryngoscopy and intubation without complications, while administering larger doses increased the risk of transient tachycardia. A study by Panda et al. in 2013 has reported the effectiveness of $MgSO_4$ 30 mg/ kg BW, 40 mg/ kgBW, and lidocaine 1.5 mg/ kgBW in preventing post-intubation hemodynamic fluctuation in patients with a history of controlled hypertension. They found that $MgSO_4$ 30 mg/kgBW is the optimal dose used in preventing hemodynamic turbulence, and subsequently, increased doses can lead to hypotensive risk (Boham, 2013).

Another supportive study is Montazeri and Falah's research in 2005, which premedicated $MgSO_4$ and lidocaine in lowering cardiovascular response to laryngoscopy and intubation (Montazeri, 2005). In their studies using $MgSO_4$ dosages of 10, 20, 30, 40, and 50 mg/kg BW compared to lidocaine 1 mg/kg BW obtained the results a dose of $MgSO_4$ 30 mg/kgBW effects decrease cardiovascular response to laryngoscopy and intubation measures better than doses 10 and 20 mg/kgBW but no significant difference to Magnesium sulfate 40 and 50 mg/kgBW (Montazeri, 2005). Magnesium sulfate has been shown to reduce hypertensive response in intubation. $MgSO_4$ plays important role in inhibiting the release of catecholamines from adrenergic nerve terminals and adrenal medulla which then reduce adverse cardiovascular effects during laryngoscopy and intubation (Mendonca 2017; Montazeri 2005).

Magnesium sulfate has been reported to be effective in treating perioperative pain and lowering somatic, autonomic, and endocrine reflexes stimulated at the time of action (Goarya 2014; Do 2013). $MgSO_4$ has been shown to have antinociceptive mainly due to its antagonistic effect on NMDA receptors, calcium ions and inhibits of catecholamines from adrenergic terminal nerves and adrenal medulla (Do, 2013).

STRENGTH AND LIMITATIONS

This study was performed in healthy patients scheduled for elective surgeries. The technique used for anesthesia induction caused some degree of hypotension, which was well tolerated in this population. Therefore, our results may not extend to emergency surgery or elderly patients or patients with ASA 3 or 4 in which the hemodynamic change may be poorly tolerated.

Another limitation is that we did not evaluate the effect on hypertensive and cardiac patients. In addition, plasma catecholamine level, a point of measuring hemodynamic stress response, was not measured in our study as we did not have catecholamine kits in our hospital.

CONCLUSION

Both intravenous $MgSO_4$ 30 mg/kgBW and lidocaine 1.5 mg/kgBW can be used to blunt the hemodynamic response due to intubation action. However, the administration of $MgSO_4$ dose 30 mg/kgBW bolus intravenously is more effective in lowering hemodynamic response than intravenous lidocaine 1.5 mg/kgBW.

CONFLICT OF INTERESTS

The study was supported by the Faculty of Medicine of Sebelas Maret University and Dr. Moewardi General Hospital Surakarta. No other party than those mentioned were involved in this study.

AUTHORS CONTRIBUTION

The first author did the idea, writing, research, and report making. The second author assisted in drafting ideas, giving direction in research, as well as improving reports.

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