MAGNESIUM SULPHATE VERSUS LIGNOCAINE AT INDUCTION FOR HEMODYNAMIC RESPONSE IN PATIENTS UNDERGOING CARDIAC SURGERY

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ABSTRACT

Objective: To compare the hemodynamic stability during laryngoscopy with magnesium sulphate versus lignocaine in patients undergoing cardiac surgery at a tertiary cardiac centre.

Study Design: Prospective observational study.

Place and Duration of Study: Adult Cardiac Surgery department, National Institute of Cardiovascular Diseases, Karachi Pakistan, from Jan and Apr 2021.

Methodology: This study evaluated 100 patients ASA II, III & IV, aged 18-65 years that were planned for cardiac surgeries after performing intubation procedure under general anesthesia. The patients had been divided into groups of two: group A received dose of 1.5 mg.kg-1 of lignocaine and group B, dose of 50 mg.kg-1 of drug magnesium sulphate, before anesthetic induction. Heart rate and blood pressure are two parameters that had been measured in two groups before intubation and 5 minutes after intubation after delivering both study drugs.

Results: In both groups there was an increase in HR and BP at laryngoscopy and intubation. Among patients receiving Magnesium sulphate and lidocaine, both groups showed good efficacy and stability for hemodynamic management after laryngoscopy and intubation thus magnesium sulphate has proven to be a potential alternative.

Conclusion: Doses of magnesium sulfate are quite enough to attenuate the response of hemodynamics to intubation of trachea, with results parallel to drug lidocaine.

Keywords: Hemodynamics, Intubation, Laryngoscopy, Lignocaine, Magnesium.

INTRODUCTION

Anesthesiologists are usually concerned regarding changes encountered in hemodynamic parameters during and usually after providing endotracheal intubation procedure (ETI) when patients are planned for cardiac procedures. The response to hemodynamics to certain amounts of stimuli that occurs during intubation and laryngoscopy is a common occurrence, due to the release of internal catecholamines that are directed to the upper airway tract afferent upon stimulation[1]. Thissurplus response can augment perioperative mortality, especially in those patients who have underlying coexisting disease, especially those patients who have cardiovascular disease. Guarding of this defensive body mechanism is prudent to prevent adverse actions, such as, pulmonary hypertension, tachycardia, arrhythmias, systemic hypertension and that may end up in stroke or cardiac arrest due to hemodynamic instability that was produced by laryngoscopy and intubation. Many drugs have been investigated in this regard including magnesium sulphate[1-3], and lidocaine [4-6]. The fruitful effects of using magnesium sulphate (MGS) as a component to anesthetic drugs in improving various intraoperative conditionsfor instance reducing hemodynamic instability had been hypothesized[1,28]. MGS halts release of catecholamines from peripheral nerve adrenal medulla and blocks nerve endings which further activate catecholamine receptors. Therefore, MGS is responsible for sympathetic activity block as a result causes dilation of blood vessels which further declines blood pressure (BP)[7]. Magnesium has been considered in medicine as a multipurpose drug with numerous clinical applications in various fields of medicine. Being an important cation Mg++ has a very important role in normal body functioning and its homeostasis is prudent. The analgesic effects of this drug are mainly due to blocking action of NMDA receptor. Mg^{++} is responsible for important cardio protective actions and is considered a proven remedy for disturbances of heart rhythm and in myocardial infarcts. Its role has been proven in anesthesia, ICU and obstetrics[12]. Magnesium sulphate reversal agent is calcium gluconate which adds more benefits for the use of this drug[11].

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Hesitation of using magnesium sulphate by our anesthetists is seen although its efficacy is internationally proven thus local data is deficient. Thus, this study was designed to give a holistic view regarding the clinical importance of magnesium sulphate in blunting hemodynamic response to tracheal intubation during cardiac surgery. Therefore, aim of this study was to compare the hemodynamic stability during laryngoscopy with magnesium sulphate versus lignocaine in patients undergoing cardiac surgery at a tertiary cardiac centre.

METHODOLOGY

This prospective observational study was initiated after approval of ethical review committee at department of Adult Cardiac Surgery, National Institute of Cardiovascular Diseases, Karachi, from January to April 2021. One hundred patients, ASA II, III & IV aged between 18-65 years, undergoing cardiac surgery with endotracheal intubation (ETI), received either Magnesium Sulphateor Lignocainefor hemodynamic stability during laryngoscopy. Patients with contra-indications or history of known hypersensitivity to the study drugs and expected difficult intubation or patients who refused to participate and who required two or more attempts at laryngoscopy for orotracheal tube placement were also excluded.

Considering the expected mean post intubation systolic blood pressure of 97.7 ± 16.9 mmHg vs. 115.5 ± 25.3 mmHg, as reported by Kiaee *et al*[13], with an expected effect size of 0.827, at 5% level of significance and 80% power of test, the minimum required sample size for the study was calculated to be 19 patients in each group. However, considering the variations in other hemodynamic parameter we have decided to enroll 50 patients in each group i.e. 100=50 in lignocaine + 50 in $MgSO4$.

Prior to inclusion purpose, benefit, and associated potential risk were explained to all the patients and verbal informed consent was obtained regarding their participation in the study and publication of acquired data without disclosing their identity. Demographic details such as gender, age, co-morbid conditions, and diseases and type of surgery were recorded.

After anesthesia fitness, patient undergoing elective cardiac surgery were chosen. Anesthetic management for all the patients were similar. Baseline hemodynamic parameters including systolic, diastolic blood pressure (BP), mean arterial pressure (MAP), and heart rate (HR) were measured immediately before anesthetic intubation. Drug type (Magnesium Sulfate 50 mg/kg or Lignocaine 1.5 mg/kg) and dose used at the time of intubation was recorded choice of drug type was at the discretion of anesthesiologist. Required number of consecutive patients receiving either type of drug were enrolled for this study through non-probability consecutive sampling technique.

All patients had been premedicated by alprazolam oral (0.5mg) 12 hour before their scheduled surgery time and ringer solution infusion was then started. After this step preoxygenation was done with fraction of inspired oxygen (FIO2) of 1.0, anesthesia was now induced with midazolam (20µg/kg), nalbuphine (10-20mg), propofol (2mg/kg), and drug atracurium (0.5 mg/kg). After passing 3 minutes, intubation of the patients were performed with the appropriate size, cuffed endotracheal tube (ETT). An expert anesthesiologist was approached who carried out intubations. Then anesthesia was carried out with isoflurane according to MAC and bolus administred of atracurium (10 mg) every 20 minutes required. Ventilation had been stopped in all study groups during cardiopulmonary bypass period. After completion of bypass procedure, lungs were then manually reinflated under strict direct observation provided with of 20 cm H2O continuous positive airway pressure CPAP.

Hemodynamic parameters such as systolic, diastolic blood pressure (BP), mean arterial pressure (MAP), and heart rate (HR) were recorded before intubation and 5 minutes after intubation. Unfavorable events associated with the use of both type of drugs were also recorded. All the collected data was recorded on a predefined structured proforma and collected data was accessible to the authorized persons only.

All statistical analyses were performed using SPSS-23). Data were expressed as mean ± standard deviation for quantitative variables and summarized by absolute frequencies and percentages for categorical variables. Comparison of differences in hemodynamic parameters such as systolic, diastolic blood pressure (BP), mean arterial pressure (MAP), and heart rate (HR) between the two treatment groups, Lignocaine and magnesium sulphate, were made by applying independent sample t-test for continuous variables and hemodynamic stability was compared by applying chi-square test or Fisher's exact test. A p-value ≤0.05 was considered statistically significant.

RESULTS

No statistical difference could be appreciated in both groups regarding age, sex, co-morbid conditions and type of cardiac surgeries performed, except CVD, ASD, and VSD (table-I). There was no significant statistical difference between Lignocaine and Magnesium Sulphate groups in HR, SBP, DBP and MAP values at the time of intubation (table-II).

Significantly higher improvement in HR, SBP, DBP and MAP were observed after 5 minutes of intu-

Table-I: Demographic and clinical characteristics of the study participants.

	Drug		*p*-value
	Lignocaine	Magnesium Sulphate	
Total (N)	50	50	-
Gender			
Male	26 (52%)	34 (68%)	0.102
Female	24 (48%)	16 (32%)	
Age (years)	50.3 ± 13.01	49.02 ± 11.26	0.600
≤ 65 years	40 (80%)	47 (94%)	0.037*
> 65 years	10 (20%)	3 (6%)	
Major Co-Morbid Condition			
Chronic kidney disease	4 (8%)	7 (14%)	0.338
Hypertension	26 (52%)	28 (56%)	0.688
Valvular heart diseases	9 (18%)	4 (8%)	0.137
Diabetes mellitus	5 (10%)	11 (22%)	0.102
Cerebrovascular accident (CVA)	6 (12%)	0 (0%)	0.012*
Type of Surgery			
Coronary artery bypass grafting	25 (50%)	34 (68%)	0.067
Mitral valve repair/replacement	9 (18%)	12 (24%)	0.461
Aortic valve repair/replacement	5 (10%)	4 (8%)	0.727
Atrial septal defect (ASD)	5 (10%)	0 (0%)	0.022*
Ventricular septal defect (VSD)	6 (12%)	0 (0%)	0.012*

**Significant at 5%*

bation in Magnesium Sulphategroup as compare to Lignocaine. Patients in both the groups were hemodynamically stable after 5 minutes of intubation. No patient received atropine or ephedrine. At intubation, patients who were given MGSO4 showed stable results demonstrating controlled and sustained vitals similar to lignocaine. Mean and standard deviation was calculated for SBP, DBP, HR, and MAP before and 5 minutes after intubation (table-II).

DISCUSSION

As illustrated previously by author Ramires *et al*[10], and author Nooarei *et al*[7], it was noticed that an evident increase in heart rate was witnessed in Group A at the end period of infusion of magnesium sulfate, which was physiologically demonstrated by the potent vasodilator action of magnesium sulphate[2,7,10,11,26-28]. Other than its beneficent effects on vasodilation, there was a greater inclination towards hypotension in magnesium sulphate group, but without any kind of statistical importance. It can relax patients even in difficult intubations. Airway maintenances during intubation

Table-II: Comparison of heamodynamic parameters between lignocaine and magnesium sulphate group.

	Drug		*p*-value
	Lignocaine	Magnesium Sulphate	
Total (N)	100	100	-
Systolic Blood Pressure (SBP) mmHg			
At the time of intubation	162.02 ± 23.78	162.46 ± 29.9	0.935
5 minutes after intubation	149.16 ± 14.78	132.4 ± 10.6	<0.001*
ΔSBP	-12.86 ± 21.36	-30.06 ± 20.12	<0.001*
p-value	<0.001*	<0.001*	-
Diastolic Blood Pressure (DBP) mmHg			
At the time of intubation	81.34 ± 23.18	83.46 ± 9.32	0.550
5 minutes after intubation	81.96 ± 6.23	74.36 ± 6.68	<0.001*
ΔDBP	0.62 ± 22.91	-9.1 ± 8.55	0.006*
p-value	0.849	<0.001*	-
Heart Rate (HR) bpm			
At the time of intubation	92.56 ± 10.94	92.56 ± 6.98	>0.999
5 minutes after intubation	91.96 ± 10.67	86.74 ± 4.73	0.002*
ΔHR	-0.6 ± 10.07	-5.82 ± 4.89	0.001*
p-value	0.675	<0.001*	-
Mean arterial pressure (MAP) mmHg			
At the time of intubation	112.24 ± 11.14	110.1 ± 12.92	0.377
5 minutes after intubation	103.86 ± 7.11	93.42 ± 5.06	<0.001*
ΔMAP	-8.38 ± 11.04	-16.68 ± 10.67	<0.001*
p-value	<0.001*	<0.001*	-

**Significant at 5%*

and laryngoscopy cause physiological disturbances that can be detrimental to a majority of subjects[12]. Sympathetic and parasympathetic fibers innervate upper respiratory tract larynx, trachea, carina and pharynx. Defensive mechanism of reflexes to airway stimulation include bronchospasm, tachycardia and intracranial pressure and rise in blood pressure. Studies have demonstrated that laryngoscopy is a procedure which is responsible for abrupt rise in about 20 mmHg rise in blood pressure particularly systolic[12-19]. Thus even a simple tracheal suction can end up in at least a 5 mmHg rise in intracranial pressure[12,18,19]. Lidocaine and drug magnesium sulfate have been considered as effective pharmacological agents as they are capable to decline the hemodynamic response to management of airways, with good results[1,3,7,10,25]. Magnesium sulfate halts the activity of adrenal gland through inhibition of catecholamines[1,7,10,23,24], it has antiarrhythmic action [10,20], as well as cardioprotective action and increases coronary and systemic vasodilation through its antagonistic action on calcium ion in vascular smooth muscle [1,7,10,21]. Lidocaine antagonizes NMDA receptors, sodium channels, decreases the release of chemical substance P, which can have glycinergic effect[8,9], that will end up in inhibiting reactivity of airways[4]. Another study that was carried out by Nooraei *et al*, where authors have seen the comparable effects of lidocaine and magnesium sulfate on all hemodynamic values during laryngoscopy. Even blood pressure values with drug magnesium sulfate have found better control[7]. The author Puri *et al*[1], has also compared the beneficial effects of drug magnesium sulphate and lidocaine on cardiovascular response to intubation procedures in cardiac subjects undergoing elective CABG procedures and have found significant blunting of variables associated with hemodynamics with magnesium sulfate. Hemodynamic results appeared to have a higher cardiac index, with less effective increase in heart rate, and remarkable decline in systemic vascular resistance. The results that came for conducting the previous study differ from the present study most probably due to the difference in tested doses of the drugs studied. Magnesium sulfate as 60 mg.kg-1 and lidocaine as 1.5 mg.kg-1 were t mg.kg-he two drugs prefered by Noorei *et al*[7], and these two drugs had been used by Puri *et al*[1], as well in doses 50 mg.kg-1 for magnesium sulfate and 1 mg.kg-1 for lidocaine. According to author Panda *et al*[3], magnesium sulphate drug were calculated at 3 different doses namely 30 mg.kg-1, 40 mg.kg-1 and 50 mg.kg-1 of drug magnesium sulfate and 1.5 mg.kg-1 of drug lidocaine and it was deduced that magnesium sulfate is a potential candidate in providing stability and good results compared to the drug used as control group namely lidocaine[3]. According to the data another study has also used 50 mg/kg Magnesium sulphate dose in a five-minute period before any induction of anesthesia. This chosen dose has been proven to maintain a stable and smooth decline in MAP with decrease in heart rate but without any signs of no abrupt hypotension[13]. Therefore we chose magnesium sulfate dosage to be 50 mg.kg-1. Vivancos *et al*, has also conducted a study on the following dose and proven effective[4]. His study had been performed on healthy subjects that were planned for cardiac procedures. While conducting this study same technique of anesthetic induction was chosen with some degree of hypotension which was well below the tolerated dose for the population. It is often seen that magnesium becomes the culprit drug for a dose-dependent rise of neuromuscular blockers (NB). Fortunately this adverse effect is not observed in our study as cardiac surgeries are usually prolonged so non-depolarizing neuromuscular blockers[22], such as rocuronium does not cause any detrimental effect in cardiac surgeries if used in combination with magnesium sulphate.

CONCLUSION

It has been observed that magnesium sulfate doses are sufficient to blunt the hemodynamic response to tracheal intubation, with results comparable tolidocaine. We conclude that the used doses of magnesium sulphatehad good efficacy and stability in achieving hemodynamic control during laryngoscopy and intubation with no observed complicationsthus being a reliable alternative in controlling the stimulation of upper airway in patients undergoing cardiac surgeries.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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