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Comparison of the Intubating Conditions and Changes in the Haemodynamic Responses Following Larygoscopy and Intubation with or without Pretreatment of Magnesium Sulphate

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Abstract: ***Aim:*** ***To compare the intubating conditions and haemodynamic conditions following laryngoscopy and intubation with or without pretreatment of magnesium sulphate in adult patients. Methods: This study was conducted in the Department of Anaesthesiology, RIMS, Ranchi, Jharkhand, India during 2007-2009. It was a prospective, randomized, double- blinded study in which 50 adult patients of age group 18-60 years undergoing various elective routine surgery were undertaken randomly. Out of these, 25 patients were given magnesium sulphate infusion i.vi.e Group I ($MgSO_4$ Group)and the remaining 25 were given saline infusion i.v i.e Group II (Control Group). An anaesthesiologist, blinded to the group assignment, performed direct laryngoscopy and endotracheal intubation and intubating conditions were assessed. Heart rate (HR) and Mean arterial blood pressure (MAP) were recordedbefore induction, after induction, just after intubation and 2 minutes after intubation. Results: The two groups were comparable in their demographic profiles and airway features. There was improved intubating conditions in Group I patients when compared to Group II patients. The result was considered to be statistically significant (P<0.05).There was increase in HR and MAP in Group II than in Group I but the increase in HR and MAP was statistically significant (P<0.05) only just after intubation in Group II when compared with Group I. Conclusion: Pretreatment of magnesium sulphate prior to induction improved the intubating conditions and haemodynamic changes just after intubation thus provides the better haemodynamic stability during direct laryngoscopy and intubation. Thus, beneficial in patients with cardiovascular or cerebrovascular diseases where it is necessary to prevent pressor responses.***

Keywords: Magnesium sulphate, Intubating conditions, Heart Rate (HR), Mean arterial Blood Pressure (MAP), Rocuronium bromide.

1. Introduction

The primary role of anaesthesiologists is to secure and maintain patent airway. Endotracheal intubation is an important part of general anaesthesiaand it is one of the best methods of securing patent airway. Good intubating conditions minimize the risk of trauma associated with tracheal intubation. Intubating conditions (muscle tone, vocal cord positions, reaction to laryngoscopy and tube positioning) depend on anaesthetic depth. General anaesthesia with endotracheal intubation is a time tested procedure practiced all over the world. Direct laryngoscopy and intubation of trachea was considered safe until the hemodynamic stress response to airway manipulation, laryngoscopy and intubation was demonstrated by King et al. in 1951, which is characterized by an increase in HR and rise in BP [1] This is transiant and insignificant in healthy individuals, but may be harmful in high risk patients such as patient with history of hypertension or Ischaemic Heart Disease (IHD), recent myocardial infarction, coronary artery diseases and cerebrovascular diseases. Many pharmacological and non-pharmacological methods have evolved over time to attenuate this pressor response to airway manipulation, laryngoscopy and intubation. Neuromuscular blocking agents has revolutionized the anaesthetic practice completely as they facilitate the tracheal intubation. The choice of induction agents, muscle relaxants, various agents and technique may affect the ease of intubation, haemodynamic stability and thus the outcome of patients.

Rocuronium bromide is a non-depolarizing steroidal muscle relaxant, derivative of vecuronium, introduced in 1994 became the first competitor of suxamethonium. Its mechanism of action is competitive non- depolarizing neuromuscular block with high degree of selectivity for post-nicotinic cholinergic receptors of skeletal muscles. It has rapid onset, good to excellent intubating conditions within 60-90 seconds after administration of 0.6 mg/kg dose as shown by Toni Magorian et al [2] , Fuchs Buder et al [3] and P. Schultz et al [4]. It has intermediate duration of action with good haemodynamic stability as demonstrated by Eamon P. McCoy et al [5] and Mark E Hudson et al [6]. Also no clinical evidence of histamine release in wide variety of patients as shown by Levy and Jerold H. et al [7].

Magnesium sulphate ($MgSO_4$) has been used in the treatment of pre-eclampsia, eclampsia and hypertension [8] [9]. Recently the appreciation of the multiple actions of magnesium within the cell, has led to the marked increase in its use in clinical practice. Magnesium is the fourth commonest mineral salt in humans and plays a fundamental role in many physiological processes, for example neuronal activity, muscular contraction and control of vasomotor tone [10] [11] [12]. Magnesium is known to possess muscle relaxing effects mostly by reducing acetylcholine release and it seems to have antinociceptive and anaesthetic effects [10] [11]. It has anti-adrenergic effects by decreasing catecholamine release from the adrenal medulla or adrenergic nerve endings and it causes vasodilation and an anti-arrhythmic effect on the heart [11] [12]. Considering all these advantages of $MgSO_4$, we hypothesized that with

$MgSO_4$ pretreatment, intubating conditions would improve and the haemodynamic responses following laryngoscopy and intubation would be more stable. Thus, the aim of our study was to compare the intubating conditions and haemodynamic conditions following laryngoscopy and intubation in adult patients with or without pretreatment of magnesium sulphate.

2. Materials and Methods

This randomized, prospective, double- blinded study was done in Rajendra Institute of Medical Sciences (RIMS) , Ranchi, Jharkhand during 2007-2009. A total number of 50 patients of ASA grade I & II of either male or female sex aged between 18-60 years, weight between 40-80 kgs. with Malampatti class I and II undergoing elective surgical procedures were included in this study. After obtaining approval from institutional ethical committee, written informed consents were taken from all the patients. Routine investigations were done. Method chosen for allocation was simple random sampling. Patients were randomly distributed into both groups: **Group I ($MgSO_4$ Group):** Out of these, 25 patients were given magnesium sulphate ($MgSO_4$)60 mg/kg diluted in normal saline making it total 100 ml as an intravenous infusion over ten minutes before induction. **Group II (Control Group):** The remaining 25 patients were given 100 ml of normal saline as an intravenous infusion ten minutes before induction. Patients with Malampatti class >III, morbid obesity, respiratory tract pathology, limited mouth opening, any risk of aspiration/regurgitation, ischemic heart diseases, diabetes mellitus, COPD, and anticipated difficult airway were excluded from the study. After taking a written informed consent, all patients were kept nil orally for at least 8 hours prior to surgery. All patients were properly counselled regarding the type of the anaesthetic procedure. All patients in both groups were premedicated with diazepam 0.2mg/kg orally on the night prior to surgery. Inj. Glycopyrrolate 0.01mg/kg intramuscular an hour prior to induction were given to all patients. When patients arrived in the operation theatre, they were placed in the supine position. All the patients were connected to multipara monitor and HR, NIBP, SpO2 and ECG were monitored. Intravenous line was secured. Baseline heart rate and Mean arterial blood pressure (MAP) were recorded before induction of anaesthesia. All patients were pre-oxygenated for 3 minutes. Inj. Ranitidine 50mg, Metoclopramide 10mg and inj. Midazolam 0.03mg/kg were given intravenously and analgesia was achieved with Inj. Butorphenol 0.06mg/kg i.v. Patients were induced with Inj. Propofol 2mg/kg and Inj. Rocuronium 0.6mg/kg was given i.v. An anaesthesiologist, blinded to the group assignment, performed direct laryngoscopy and endotracheal intubation2 minutes after administration of Rocuronium. The view of the larynx was assessed using the modified Cormack and Lehane classification [13]. Intubating conditions were assessed as excellent, good or poor, according to the criteria described by Caroll et al [14].

[Appendix I]
Assessment of intubating conditions

		Excellent	Good	Poor
A.	Laryngoscopy			
	Jaw relaxation	Relaxed	Relaxed	Poor relaxation
	Resistance to blade	No resistance	Slight resistance	Active resistance
B.	Vocal cords			
	Position	Abducted	Intermediate	Closed
	Movement	None	Moving	Closing
C.	Reaction to intubation			
	Movement of limbs	None	Slight	Vigorous
	Coughing	None	Diaphragm	Sustained > 10s

After intubation, bilateral air entry was confirmed by auscultation and the cuff was inflated. The endotracheal tube was secured with an adhesive tape. After intubation, maintenance of anaesthesia was done with 66% nitrous oxide (N_20) and oxygen (O_2) 33% and 0.5% Isoflurane with controlled ventilation. Adequate relaxation was maintained with intermittent bolus doses of Inj. Rocuronium 0.15mg/kg. The study parameters – heart rate (HR) and Mean arterial blood pressure (MAP) were recorded pre-operatively, before induction, after induction, just after intubation and 2 minutes after intubation. At the end of the surgery, reversal was done with Inj. Neostigmine 0.05mg/kg + Inj. Glycopyrrolate 0.2mg/kg. After proper thorough oral suctioning, patients were extubated and oxygenated with 100% oxygen by face mask.

3. Results

This study included 50 patients of either male or female sex admitted for various surgical procedures. They were divided into two groups of 25 and 25 patients each: Group I ($MgSO_4$ Group) and Group II (Control Group). All the values were expressed as mean ± standard deviation (SD). Statistical analysis were done by repeated measure of variants followed by student’s ‘t’ test. A probability value of $p<0.05$ was regarded as statistically significant. The demographic data of patients are shown in the following table 1.

Table 1: Epidemiological Details and airway features of Patients in Group I and Group II

	Group I (n=25) ($MgSO_4$ Group)	Group II (n=25) (Control Group)	p-value
Age (years) (Mean ± SD)	34.12 ± 10.63	34.76 ± 9.83	0.82
Weight (kgs) ((Mean ± SD)	55.2 ± 7.11	55.88 ± 5.76	0.71
Sex (%)			0.77
Male	15 (60%)	14 (56%)	
Female	10 (40%)	11 (44%)	

ASA (%)			0.57
I	14 (56%)	12 (48%)	
II	11 (44%)	13 (52%)	
MPG (%)			0.39
I	15 (60%)	12 (48%)	
II	10 (40%)	13 (52%)	
Cormack-Lehane Score (%)			0.57
I	14 (56%)	13 (52%)	
II	10 (40%)	9 (36%)	
III	1 (4%)	3 (12%)	

The groups were matched for their demographic data. Table 1 show that the average age of patients in group I was 34.12 with a SD of 10.63 while it was 34.76with a SD of 9.83 in group II and average weight of patients in group I was 55.2 with a SD of 7.11 while it was 55.88 with a SD of 5.76. There was male preponderance in both groups with 60% in group I and 56% in group II. Table 1 also shows that airway features were comparable in both the groups.

Table 2: Intubation scores in Group I and Group II [Based on the score described by Caroll et al, 1998]

Intubating conditions scores	Group I ($MgSO_4$ Group) (n=25) (%)	Group II (Control Group) (n=25) (%)	p-value
Excellent	20 (80%)	7 (28%)	0.001
Good	4 (16%)	14 (56%)	
Poor	1 (4%)	4 (16%)	

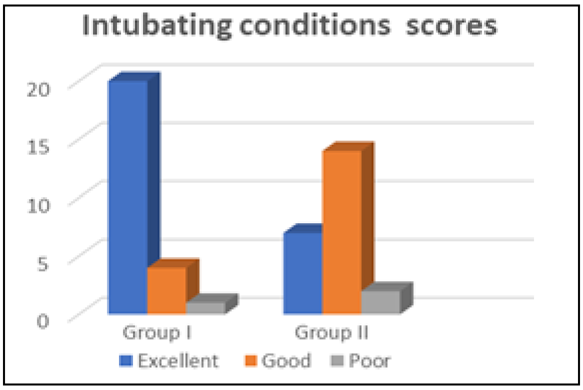

Figure 1

Table 2 and figure 1 show that intubating conditions were excellent in 20 patients (80%) in Group I while they were excellent in 7 patients (28%) in Group II; good in 4 patients (16%) in Group I while they were good in 14 patients (56%) in Group II and poor in 1 patient (4%) in Group I while they were poor in 4 patients (16%) in Group II. The result was considered to be statistically significant (P<0.05).

Table 3: Statistical Comparison of HR and MAP at Various Time Intervals between Both Groups

Time Interval	HR				MAP			
	Group I ($MgSO_4$ Group) Mean ± SD	Group II (Control Group) Mean ± SD	p-value	t-value	Group I ($MgSO_4$ Group) Mean ± SD	Group II (Control Group) Mean ± SD	p-value	t-value
Before induction	81.68 ± 7.54	82.72 ± 7.76	0.63	0.48	97.64 ± 4.14	99.68 ± 5.58	0.14	1.46
After induction	82.16 ± 7.50	85.44 ± 7.96	0.14	1.49	96.44 ± 5.37	97.76 ± 5.36	0.38	0.86
Just after intubation	100.16 ± 7.19	103.96 ± 5.35	0.03	2.12	104.27 ± 8.83	109.4 ± 5.82	0.01	2.43
After 2 minutes	91.4 ± 5.89	91.56 ± 5.67	0.92	0.09	99.0 ± 8.06	102.96 ± 6.39	0.06	1.92

Table 3 shows Mean ± SD and statistical comparison of heart rate (HR) and mean arterial blood pressure (MAP) of patients at various time intervals in both groups. There was increase in HR and MAP before induction, after induction, just after intubation and 2 minutes after intubation in Group II than in Group I. But the increase in HR and MAP were statistically significant (P<0.05) only just after intubation and increase in HR and MAP were statistically not significant (P>0.05) before induction, after induction and 2 minutes after intubation in Group II when compared with Group I.

4. Discussion

We showed that intubating conditions were improved, pressor response after direct laryngoscopy and intubation could be effectively prevented and also there was haemodynamic stability by the prior administration of $MgSO_4$.

The mechanism of action of magnesium as an adjuvant to intravenous induction is multifactorial. Magnesium is an agent with analgesic, anaesthetic and muscle relaxant effects [10] [11] [12]. $MgSO_4$ has adepressant effect on the central nervous system and is used in the treatment of eclampsia and hypertension [11] [12]. Its anaesthetic effect is suggested by a number of studies which showed significant reduction in anaesthetic requirements during both intravenous and inhalational anaesthesia [15] [16] [17] [18]. It also has an analgesic effect by interference with calcium channels and N-methyl-D-aspartate [10].

This antinociceptive agent has been used as an adjuvant to intraoperative and postoperative analgesia [19] [20] [21] [22]. Another important effect of $MgSO_4$ is on neuromuscular junction. Magnesium is considered to be a muscle relaxant like agent as neuromuscular transmission is altered by a reduction in release of acetylcholine at presynaptic motor nerve terminals [11]. Also it potentiates the effect of nondepolarizing neuromuscular blocking agents [8] [23] [24]. The hypothesis that $MgSO_4$ potentiates the opioid analgesia and enhance the action of propofol may explain better relaxation of the pharyngeal and laryngeal muscles. All the above factors and its effects on the neuromuscular junction explain the improvement of intubating conditions observed in our study in the magnesium group.

$MgSO_4$ can decrease arterial blood pressure through direct relaxing effect on blood vessels and by anti-adrenergic effects mediated by calcium antagonism. Sakuraba et al [25] reported that prior administration of $MgSO_4$ (40 mg/kg) effectively limited the intubation induced cardiovascular changes to RSI. Puri et al [26] administered $MgSO_4$ (40 mg/kg) in order to attenuate the cardiovascular response to tracheal intubation. They found that MAP and SVR decreased by 17% and 25% respectively after administration of magnesium. James et al [9] observed the use of $MgSO_4$ to control the hypertensive response to intubation and surgical stimulation because of the ability of magnesium to inhibit the release of catecholamines from adrenergic nerve terminals and from the adrenal medulla. These studies are similar to our study where there was increase in HR and MAP in Group II (Control Group) than in Group I ($MgSO_4$ Group) and this increase was statistically significant ($P<0.05$) just after intubation whereas increase in HR and MAP were statistically not significant ($P>0.05$) before induction, after induction and 2 minutes after intubation in Group II when compared with Group I.

In our study, serum concentration of magnesium was not measured. No side-effects related to hypermagnesemia were observed. Only mild symptoms such as heat or burning sensations in the arm on the side of the intravenous line in few patients of magnesium group were reported [10] which resolved spontaneously without any further management.

5. Conclusion

Our study confirmed that pretreatment with $MgSO_4$ improved the intubating conditions during direct laryngoscopy and intubation using butorphanol, propofol and rocuronium. Also it was an effective adjuvant to prevent hypertension and tachycardia following intubation thereby maintaining the haemodynamic stability. These results will be beneficial in patients with cardiovascular or cerebrovascular diseases where it is necessary to prevent severe fluctuations in HR and BP during or immediately after tracheal intubation in these patients. Also due to its effects on neuromuscular junction, it shortens the onset time, prolongs the clinical duration and increases the potency of non-depolarizing NMBA's. Thus, we should be cautious while using $MgSO_4$ with non-depolarizing NMBA's during short duration surgeries or in situations when difficult mask ventilation or difficult intubation is expected. Further studies are needed to find the most appropriate dose in older and more vulnerable ASA grade 3 and 4 patients

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