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Corresponding Author
T.K. Haridadeeswaran, Department of Anaesthesiology, ESIC Medical College and Post Graduate Institute of Medical Sciences, Rajajinagar, Bangalore, Karnataka, India

Author Designation
[1,3,4]Senior Resident
[2]Associate Professor

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Laryngoscopy and Intubation: Effect of Intravenous Magnesium Sulphate and Intravenous Esmolol on Heart Rate

[1]Meghana Badari Narayan, [2]Mohan Kumar Ramiah Mahadeva, [3]U.L. Sagarika and [4]T.K. Haridadeeswaran

[1,3,4]Department of Anaesthesiology, ESIC Medical College and Post Graduate Institute of Medical Sciences, Rajajinagar, Bangalore, Karnataka, India

[2]Department of Anaesthesiology, ESIC Medical College and Hospital, KK Nagar, Chennai, Tamil Nadu, India

Abstract
Esmolol is a phenoxy propanolamine, a molecular structure characteristic of conventional, second-generation ß-blockers. Magnesium is the fourth most common cation in the body and second most common intracellular cation after potassium. This study was undertaken to compare the effects of intravenous esmolol 30mg/kg with intravenous magnesium sulphate 30mg/kg on the heart rate following laryngoscopy and intubation. Data was collected from patients scheduled for elective surgeries under general anaesthesia with end otracheal intubation. The mean HR in esmolol group was significantly lower than magnesium sulphate group from intubation, till 10 minutes after intubation ($p<0.05$). Thus, esmolol attenuated HR response better than magnesium sulphate.

INTRODUCTION

Direct laryngoscopy and endotracheal intubation are noxious stimuli that may induce profound changes in cardiovascular physiology, primarily through reflex responses. It also results in responses in the respiratory and central nervous system[1].

It is mediated by a polysynaptic reflex arc. Mechanoreceptors, stretch receptors and polymodal ending of nonmyelinated nerve fibers located in the epipharyngeal, laryngopharyngeal and tracheal regions are stimulated. Afferent impulses are relayed through the glossopharyngeal and vagus nerves to the brainstem. Efferent impulses cause widespread activation of the autonomic nervous system mediated by the cardioaccelerator fibers and sympathetic chain ganglia. This response causes widespread release of norepinephrine from adrenergic nerve terminals, secretion of epinephrine from the adrenal medulla and activation of the renin-angiotensin system[2].

Magnesium is the fourth most common cation in the body and second most common intracellular cation after potassium. Magnesium is involved in several processes including hormone receptor binding, gating of calcium channels, transmembrane ion flux and regulation of adenylate cyclase, muscle contraction, neuronal activity, control of vasomotor tone, cardiac excitability and neuro transmitter release. Magnesium is also required for sensitivity of target tissues to PTH and Vitamin D metabolites[3].

Esmolol is a phenoxypropanolamine, a molecular structure characteristic of conventional, second-generation ß-blockers. It contains an ester functionality in the para-position of the phenyl-ring. The presence and location of this ester are of fundamental importance in the determination of esmolol's cardioselectivity as well as its ultrashort duration of action[4].

MATERIALS AND METHODS

Source of Data: Data was collected from patients scheduled for elective surgeries under general anaesthesia with endotracheal intubation in the Department of Anaesthesiology.

Study Design: A prospective randomized study

Inclusion Criteria:

- Patient willing to give informed consent.
- American Society of Anaesthesiologists (ASA) class I patients.
- Aged between 18-60 years posted for elective surgeries under general anaesthesia with endotracheal intubation.

Exclusion Criteria:

- Unwilling to participate in the study.
- Allergy to the study drugs.
- Anticipated difficult airway.
- Emergency surgical procedures.
- Patients requiring rapid sequence induction and intubation.
- Baseline heart rate less than 60bpm, baseline systolic blood pressure less than 100mmHg.
- PR interval > 0.24sec, 2nd or 3rd degree heart block on ECG.
- Sick Sinus Syndrome.

Method of Study and Collection of Data: Following ethical committee approval, patients fulfilling the essential criteria were selected. Detailed pre-anaesthetic evaluation was done. An informed and written consent was taken from all patients. Demographic (age, gender), morphologic (weight, height) and vital parameters were recorded. The patients were randomly divided into 2 groups of 36 each using a computer-generated randomization table. The patient and the anaesthesiologist were blinded to the drug to be used. An observer who was not involved further in the study administered the study drugs.

Group E: Esmolol group (n = 36) received 100mL plain NS over 10 minutes before induction and 0.5mg/kg esmolol diluted to 10mL given IV over 60seconds after induction.

Group M: Magnesium sulphate (MgSO4) group (n = 36) received 30mg/kg magnesium sulphate in 100mL NS given IV over 10minutes before induction and 10mL plain NS given IV over 60seconds after induction.

The same anaesthesiologist did laryngoscopy and intubation for both the study groups and vital parameters were recorded.

RESULTS AND DISCUSSIONS

The mean (±SD) age of participants in esmolol group was 31.9(±9.3) years and that in magnesium sulphate group was 35.3(±8.3) years. There was no statistically significant difference in the age of participants between the two groups (p-0.105).

Number of male participants were 55.6% in esmolol group and 41.7% in magnesium sulphate group. Number of female participants were 44.4% in esmolol group and 58.3% in magnesium sulphate group. There was no statistically significant difference in the gender distribution between groups (p-0.238).

The mean weight (±SD) of participants in esmolol group was 64.2(±9.9) kg and that in magnesium sulphate group was 60.2(±8.0) kg. There was no

statistically significant difference in the weight of participants between the two groups (p-0.065).

The mean height (±SD) of participants in esmolol group was 162.3(±8.5) cm and that in magnesium sulphate group was 160.4(±6.0) cm. There was no statistically significant difference in the weight of participants between the two groups (p-0.277).

To summarize, there was no statistically significant difference in the demographic and morphologic features between both the groups and hence, they were comparable.

The mean HR in esmolol group was significantly lower than magnesium sulphate group from intubation, till 10 minutes after intubation ($p<0.05$). Thus, esmolol attenuated HR response better than magnesium sulphate.

HR within esmolol group showed statistically significant increase till 2nd minute after intubation but it was not clinically significant (maximum rise was 8bpm) and statistically significant decrease from 6th to 10th minute after intubation.

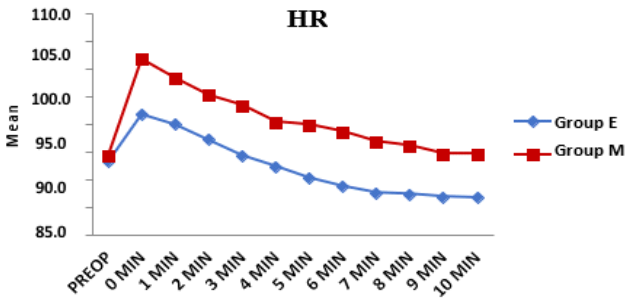
HR within the magnesium sulphate group showed statistically significant increase from intubation till 7th minute after intubation.

In our study, the mean HR in esmolol group was significantly lower (91.8±9.5 at intubation) than magnesium sulphate group (101.6±10.4 at intubation) from intubation, till 10 minutes after intubation ($p<0.05$). Thus, esmolol attenuated HR response better than magnesium sulphate. Changes in SBP, DBP and MAP between the two groups were statistically insignificant and comparable at all points. Thus, attenuation of mean SBP, DBP and MAP was comparable between the groups.

In a study done by Sharma[5] there was significantly lower post intubation HR in esmolol group (1.5mg/kg) compared to magnesium sulphate group (40mg/kg) till 5 minutes post-intubation, whereas both the drugs comparably attenuated the BP response. Another study by Aasim[6] comparing esmolol 1.5mg/kg with magnesium sulphate 50mg/kg showed a significantly lower HR in esmolol group compared with magnesium sulphate group at various intervals till 5 minutes after intubation. On comparison of MAP, there was no significant difference between study groups. Norhuzaimah[7] compared magnesium sulphate 40mg/kg with esmolol 1mg/kg and found that esmolol group had significantly better suppression of HR response up to 4 minutes after intubation. Also, esmolol group showed a significantly better attenuation in the SBP and DBP values. The above studies show that attenuation of haemodynamic response to laryngoscopy and intubation are better with esmolol compared to magnesium sulphate and the results are comparable to our study.

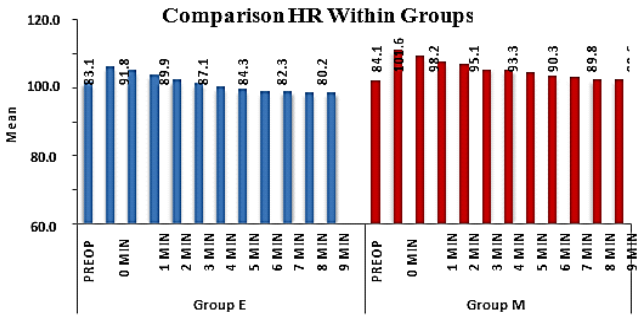
HR within esmolol group showed statistically significant increase till 2nd minute after intubation but it was not clinically significant (maximum rise was 8bpm) and statistically significant decrease from 6th to 10th minute after intubation which was clinically insignificant. Our results are comparable to a study by Bensky[8] where esmolol 0.4mg/kg administered before induction showed a statistically significant rise in HR up to 2 minutes after intubation and returned to baseline at 5 minutes after intubation. In a study by Kumar[9], patients receiving esmolol 2mg/kg bolus 2 minutes before laryngoscopy and intubation showed an increase in HR up to 3 minutes after intubation which came down to less than preoperative values 5 minutes after intubation, both of which were clinically insignificant. Our results are also similar to another study by Ray[10] where esmolol 2mg/kg administered 3 minutes prior to laryngoscopy showed an increase in HR up to 3 minutes after laryngoscopy and intubation which was clinically insignificant.

HR within the magnesium sulphate group showed statistically significant increase from intubation till 7th minute after intubation. Maximum increase in HR was at intubation (101.6±10.4), which returned to baseline, 8 minutes after intubation but however, it did not require any intervention. Our results are comparable



Note: 0 Min-at intubation

Fig 1: Comparison of HR between study groups



Note: 0 Min-at intubation

Fig 2: Comparison of HR within study groups

Table 1: Comparison of age between study groups

Parameters	Group E		Group M		p-value
	Mean	SD	Mean	SD	
AGE (years)	31.9	9.3	35.3	8.3	0.105

Table 2: Comparison of gender between study groups

	Group E		Group M		
Gender	N	percentage	N	percentage	p-value
Male	20	55.6%	15	41.7%	0.238
Female	16	44.4%	21	58.3%	
Total	36	100.0%	36	100.0%	

Table 3: Comparison of morphologic parameters between study groups

	Group E		Group M		
Parameters	Mean	SD	Mean	SD	p-value
Weight (kg)	64.2	9.9	60.2	8.0	0.065
Height (cm)	162.3	8.5	160.4	6.0	0.277

Table 4: Comparison of HR between study groups

	Group E			Group M		
HR (bpm)		Mean	SD	Mean	SD	p-value
	Preop	83.1	9.2	84.1	8.8	0.639
Intubation	0 Min	91.8	9.5	101.6	10.4	<0.001*
	1 Min	89.9	9.1	98.2	11.5	0.001*
	2 Min	87.1	8.3	95.1	12.4	0.002*
	3 Min	84.3	9.0	93.3	11.7	<0.001*
	4 Min	82.3	9.0	90.3	12.2	0.002*
	5 Min	80.2	10.1	89.8	12.7	0.001*
	6 Min	78.7	9.2	88.6	10.5	<0.001*
	7 Min	77.5	9.8	86.8	11.4	<0.001*
	8 Min	77.3	10.2	86.0	11.1	0.001*
	9 Min	76.8	9.8	84.6	11.0	0.002*
	10 Min	76.6	9.5	84.6	10.7	0.001*

Note: p value* significant at 5% level of significance (p<0.05)

Table 5: Comparison of HR within study groups

		Group E		Intra group p value from basal	Group M		Intra group p value from basal
HR (bpm)		Mean	SD		Mean	SD	
	Preop	83.1	9.2	-	84.1	8.8	-
Intubation	0 Min	91.8	9.5	<0.001*	101.6	10.4	<0.001*
	1 Min	89.9	9.1	<0.001*	98.2	11.5	<0.001*
	2 Min	87.1	8.3	0.021*	95.1	12.4	<0.001*
	3 Min	84.3	9.0	0.5	93.3	11.7	<0.001*
	4 Min	82.3	9.0	0.658	90.3	12.2	<0.001*
	5 Min	80.2	10.1	0.148	89.8	12.7	<0.001*
	6 Min	78.7	9.2	0.018*	88.6	10.5	0.002*
	7 Min	77.5	9.8	0.006*	86.8	11.4	0.047*
	8 Min	77.3	10.2	0.006*	86.0	11.1	0.147
	9 Min	76.8	9.8	0.002*	84.6	11.0	0.743
	10 Min	76.6	9.5	0.002*	84.6	10.7	0.738

Note: p value* significant at 5% level of significance (p<0.05)

to a study by Chaithanya[11] where patients receiving 30mg/kg of magnesium sulphate 10 minutes before induction showed significant rise in HR after intubation. Another study conducted by Kotawani[12] showed that patients receiving 30mg/kg of magnesium sulphate for attenuation of intubation response showed a significant rise in HR from administration of study drug up to 5 minutes after intubation with a maximum increase just after intubation (22.78% from baseline). In a study by Honarmand *et al*. there was a similar rise in HR in the group receiving 30mg/kg of magnesium sulphate before induction with a maximum rise at 3 minutes after laryngoscopy (108.0±15.1 compared to baseline of 87.5±9.3) which were comparable to our study[13,14].

CONCLUSION

In our study, the mean HR in esmolol group was significantly lower (91.8±9.5 at intubation) than magnesium sulphate group (101.6±10.4 at intubation) from intubation, till 10 minutes after intubation (p<0.05). Thus, esmolol attenuated the heart rate response better than magnesium sulphate.

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