

A Comparative Study on Two Doses of Esmolol 0.5mg/Kg and 1.5mg/Kg to Attenuate the Hemodynamic Stress Response during Laryngoscopy and Endo Tracheal Intubation

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Abstract: *This study investigates the optimal dose of esmolol to attenuate the hemodynamic response to laryngoscopy and endotracheal intubation. Conducted over six months at a tertiary healthcare center, 40 patients undergoing general surgical procedures were divided into two groups receiving either 0.5 mg/kg or 1.5 mg/kg of esmolol. Heart rate and blood pressure were monitored at baseline, during, and after intubation. The results showed that a 1.5 mg/kg dose of esmolol significantly reduced the increase in heart rate and blood pressure compared to the 0.5 mg/kg dose. The higher dose was more effective in minimizing the hemodynamic stress response, with no major side effects reported.*

Keywords: Esmolol, Hemodynamic response, Laryngoscopy, Endotracheal intubation, Beta-blockers

1. Introduction

Laryngoscopy and endotracheal intubation can trigger a significant hemodynamic stress response, particularly in patients with cardiovascular or cerebral disease¹. Numerous topical and systemic medications were employed to lessen these undesirable hemodynamic reactions brought on by laryngoscopy and intubation. Esmolol, a beta-blocker, has been found to effectively attenuate this response, with a dose of 1.5 mg/kg being the most effective^{2,3}. Esmolol, particularly at a dose of 0.5mg/kg, has also been found to be effective in attenuating the hemodynamic response to laryngoscopy and endotracheal intubation⁴. Hence, we have conducted this study to find out optimum dose at which hemodynamic response to laryngoscopy can be attenuated.

Objectives

To Compare the effectiveness of two different doses of Esmolol in attenuating the stress response to laryngoscopy and intubation with respect to heart rate, SBP and DBP variability.

2. Materials And Methods

Over the course of six months, from October 2023 to March 2024, this prospective observational study was carried out in a tertiary health care centre. Signed informed consent were obtained, and 40 individuals of ASA 1 & 2 class scheduled for various general surgical procedures planned under general anaesthesia were enrolled for the study following approval from the Institutional Ethical Committee. Patients belonging to age group 19-55 years of both the sexes were included. Patients were randomly grouped into two groups. Group L (Esmolol 0.5 mg/kg)- Twenty patients were given Esmolol 0.5 mg/kg IV 2 minutes before intubation. Group H (Esmolol 1.5 mg/kg)- Twenty patients were given Esmolol 1.5 mg/kg IV 2 minutes before intubation.

Forty-five minutes prior to induction, all patients were given premedication injections of Fentanyl (1.5 mcg/kg IV) and Inj Glycopyrrolate 4mcg/kg IV after giving an intravenous line using 18 G cannula. At this point, the blood pressure and pulse rate of each patient were noted. Before induction, ECG leads were affixed to every patient and ECG recorded. Every group used a similar induction procedure. All patients were preoxygenated for three minutes. Induction was with 1-2mg/kg of propofol, followed by 0.8 mg/kg of Inj Rocuronium and Inj. Esmolol of dosage according to their respective groups 2 minutes before intubation and the patient was ventilated with 100% oxygen. Macintosh curved blade laryngoscope was used for laryngoscopy. The patients were intubated with appropriately sized endotracheal tubes within 15 seconds of laryngoscopy. The same individual performed each intubation. After that, nitrous oxide and oxygen were manually administered to the patients.

At one minute, three minutes (during laryngoscopy and intubation), five minutes, seven minutes, and ten minutes following induction, blood pressure (systolic and diastolic) and heart rate were measured. Heart rate and blood pressure (both systolic and diastolic) were measured by the monitor. The rate pressure product and mean arterial pressure were computed. Patients were not moved or given any surgical stimulation throughout these 10 minutes of observation. Following the first ten minutes, rocuronium maintenance dosages, volatile agents, and analgesics as needed were used to maintain anaesthesia. Every fifteen minutes, data on heart rate and blood pressure were taken. At the end of surgery, patients received 0.01 mg/kg of glycopyrrolate and 0.05 mg/kg of neostigmine. After ensuring sufficient recovery in the recovery area, patients were moved to the post-operative ward.

Inclusion Criteria:

- ASA I & II
- Age 19 – 55 years
- Elective general surgical procedures requiring GA

Exclusion Criteria:

- Known difficult airway
- contraindication to esmolol
- Patients on beta blockers
- Patients posted for Emergency surgery
- Hypertension, Diabetes, Ischemic heart disease

3. Results and Observation

Demographic data:

Table 1: Demographic data

Group	Male	Female	Total
L	8	12	20
H	9	11	20
Total	17	23	40

Table 2: Comparison of mean age and BMI among groups

Group	Age	BMI
L	36.9±10.46	22.28±0.93
H	36.1±9.95	22.43±0.94
P-Value	>0.05	>0.05

There is no significant difference in mean age and BMI among the two groups

Table 3: Comparison of mean heart rate among groups

TIME	HEART RATE MEAN±SD VALUES		P value
	GROUPS		
	L	H	
BASELINE	93.15 ± 6.53 [82-103]	91.2 ± 6.98 [79-108]	>0.05
AT 1 MIN OF ESMOLOL	89.9 ± 6.95 [78-101]	86.5 ± 6.37 [75-100]	>0.05
DURING INTUBATION	107.6 ± 7.55 [95-119]	96.1 ± 7.4 [85-114]	<0.00001
AFTER 5 MIN	103.8 ± 7.37 [91-115]	91.45 ± 5.83 [82-106]	<0.00001
AFTER 10 MIN	98.2 ± 6.94 [86-109]	88 ± 5.10 [81-99]	<0.00001

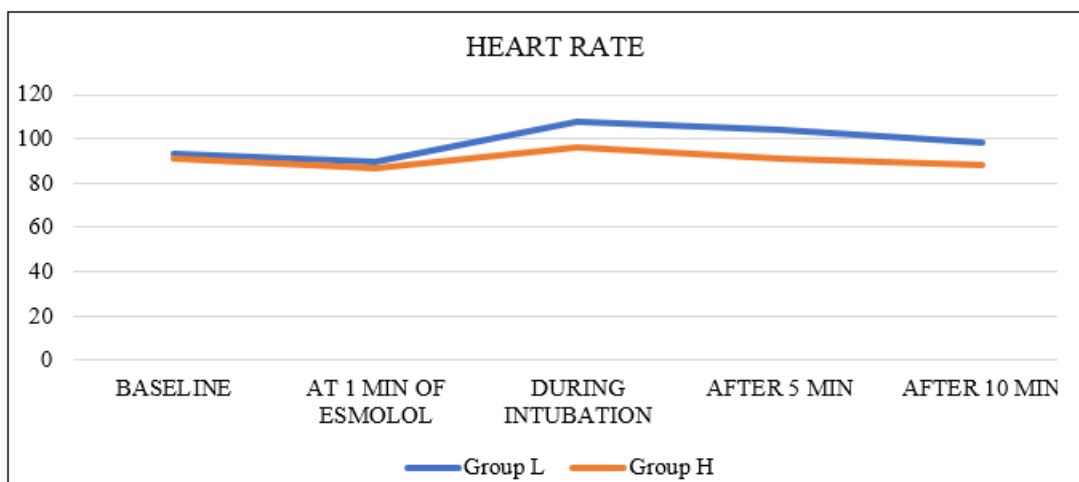


Figure 1: Comparison of mean heart rate between groups

Table 4: Comparison of mean systolic blood pressure among groups

TIME	SYSTOLIC BLOOD PRESSURE: MEAN±SD VALUES		P value
	GROUPS		
	L	H	
BASELINE	121.45 ± 7.394699	119 ± 7.290946	>0.05
AT 1 MIN OF ESMOLOL	119.1 ± 7.070323	118.05 ± 6.668662	>0.05
DURING INTUBATION	152.6 ± 9.115631	141.15 ± 6.745564	<0.00001
AFTER 5 MIN	141.65 ± 8.69528	132.4 ± 6.193375	0.0004
AFTER 10 MIN	129.35 ± 8.04772	122.95 ± 6.977219	0.01

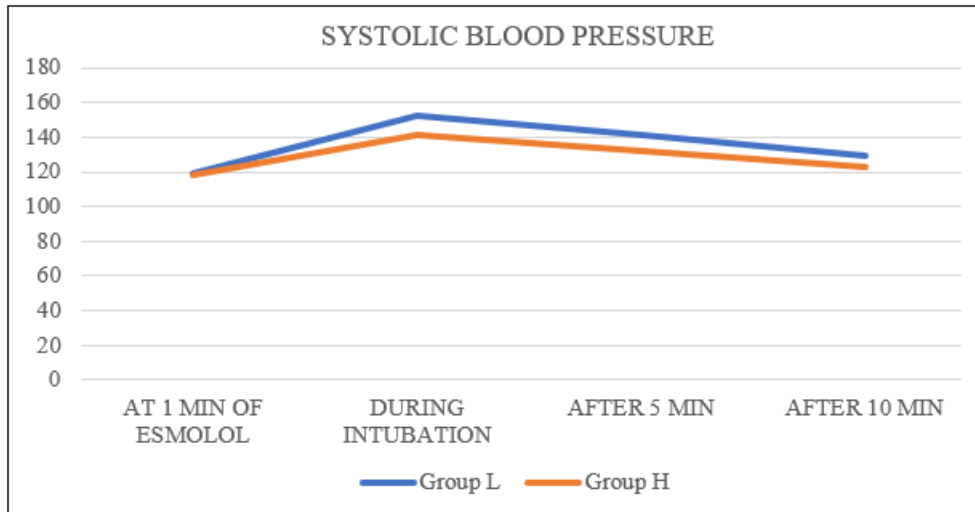


Figure 2: Comparison of mean systolic blood pressure between groups

Table 5: Comparison of diastolic blood pressure among groups

Time	Diastolic Blood Pressure: MEAN±SD Values		P value
	L	H	
Baseline	76.15 ± 5.163383	75.3 ± 5.130918	>0.05
At 1 min of Esmolol	74 ± 4.920419	73.45 ± 4.661996	>0.05
During Intubation	93.55 ± 5.771755	86.95 ± 3.70597	0.0001
After 5 Min	86.3 ± 6.000877	83.1 ± 4.076892521	>0.05
After 10 Min	79.45 ± 5.558067	78.7 ± 4.995788	>0.05

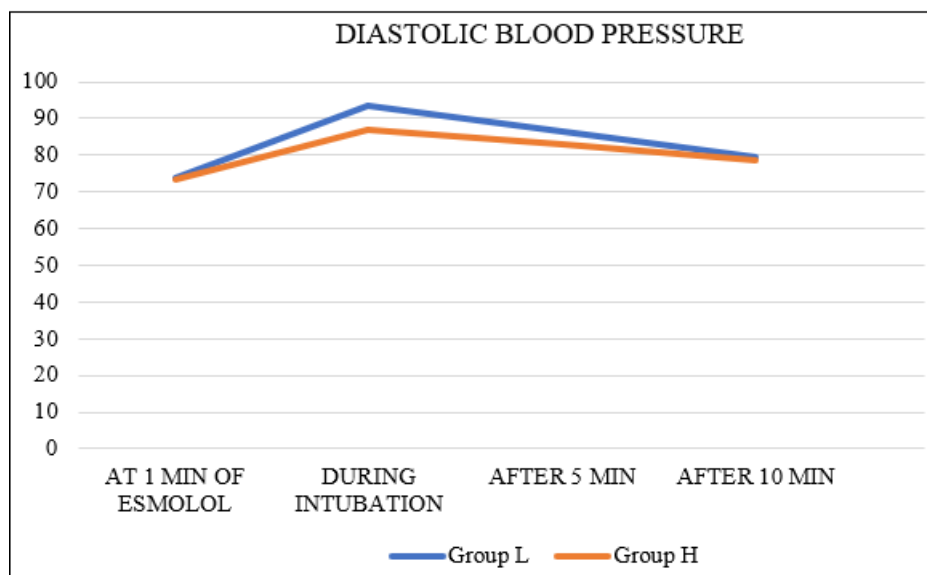


Figure 3: Comparison of mean diastolic blood pressure between groups

Table 6: Comparison of proportion of increase of vital parameters from baseline between groups

Parameters (Maximum Increase from Baseline)	Group L	Group H
Heart Rate	15%	5%
Systolic Blood Pressure	26%	18%
Diastolic Blood Pressure	23%	15%

Systolic Blood Pressure: There was up to 26 % increase in systolic blood pressure during the study period. Highest value attained during intubation and following intubation.

Diastolic Blood Pressure: There was a 23% rise in diastolic pressure from the baseline during the procedure. It was highest during and following intubation.

Group L (Esmolol 0.5mg/kg)

Heart Rate: The increase in heart rate following laryngoscopy and intubation was up to 15% from baseline. The rise in heart rate was highest during intubation. No rhythm disturbances were observed.

Group H (Esmolol 1.5 mg/kg)

Heart rate: There was only about 5% rise in heart rate from the baseline values during the entire study period. The maximum rise was observed during intubation. The rise was

modest of about 4–6 beats per minute. No rhythm disturbances were observed.

Systolic blood pressure: The rise in systolic blood pressure was about 18% during the study period. The maximum values were observed during intubation. It started declining following intubation.

Diastolic blood pressure: There was a rise of about 15% during and following intubation.

4. Observation

Heart Rate:

There is no statistical significance among the mean value of heart rate at baseline and after 1 minute of giving esmolol, but it is significantly different during the time of laryngoscopy and intubation and also after 5 minutes and 10 minutes after intubation. The heart rate was significantly less in GROUP H compared to GROUP L ($P < 0.0001$)

Systolic blood pressure:

There is no statistical significance on mean value among the two groups at Baseline and after 1 minute of administration of Esmolol ($p > 0.05$). But it is statistically significant on all other period of study ($P < 0.05$) with highest increase from the baseline during laryngoscopy and intubation. The rise in the systolic blood pressure is significantly less in Group H compared to Group L

Diastolic blood pressure:

There is no statistical significance on mean of Diastolic Blood Pressure at all the stages of study except during Laryngoscopy and intubation where it was statistically significant and comparatively less in group H than in group L. ($P < 0.05$)

5. Discussion

Tachycardia and hypertension are the hallmarks of the hemodynamic stress response that is brought on by laryngoscopy and intubation. Due to an imbalance between the oxygen supply and demand in the heart, patients with cardiac illness have a range of consequences from this neuroendocrine response, including pulmonary oedema, ventricular arrhythmias, and ST alterations.

Given the prevalence of hypertension and tachycardia during laryngoscopy, even in individuals with normal blood pressure, it may come as a surprise that problems have not occurred frequently. The fact that the hypertension is usually only present for ten minutes or less could be the cause of this. Nonetheless, an episode of hypertension and tachycardia after endotracheal intubation may be the cause of some of the difficulties that arise during intubation or even later in the anaesthesia process.

Cheeran et al.,⁵ in their study concluded that Esmolol in doses of 1mg/kg and 2mg/kg effectively attenuated the hemodynamic response to laryngoscopy and intubation. The recommended dose for attenuation of hemodynamic response to laryngoscopy and intubation is esmolol in a bolus dose of 1mg/kg given 1 minute before induction.

Krishna et al.,⁴ in their study concluded that Patients treated with esmolol showed greater resistance to abrupt excursions of heart rate and blood pressure. The dosage of 1.5mg/kg was found to be the most efficacious in attenuating the pressor response.

Analysis of our study showed that Inj. Esmolol at a dose of 1.5 mg/kg was more effective in attenuating the heart rate response to laryngoscopy and intubation compared to Inj. Esmolol at a dose of 0.5 mg/kg. Also, Esmolol 1.5 mg/kg was effective in attenuating the blood pressure increase related to laryngoscopy and intubation.

6. Conclusion

Given the factors I considered which I selected to study the hemodynamic changes expected, I found that the dose of Esmolol 1.5 mg/kg (Group H) to be effective in attenuating the hemodynamic responses during laryngoscopy and endotracheal intubation in comparison to the dose of Esmolol 0.5 mg/kg (Group L) with no major side effects of Esmolol.

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Conflicts of interest: There are no conflicts of interest

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