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Attenuation of Hemodynamic Responses to Laryngoscope and End tracheal Intubation, Role of I.V Bolus Dose of Esmolol Hydrochloride and Lignocaine Hydrochloride - a Comparative Study

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Introduction: *There is substantial evidence that laryngoscopy and endotracheal intubation in lightly anesthetized patients are accompanied by a significant increase in heart rate and arterial blood pressure . These changes are usually short duration and well tolerated by patients in the absence of cardiovascular diseases or disturbed intracranial pressure homeostasis.Various strategies have been applied to attenuate these responses. These include minimizing the duration of laryngoscopy to less than 15 seconds, use of I.V or topical lidocaine, deep inhalational anesthetics, I.V. Narcotics, adrenoceptor blocking agents, vasodilators, calcium channel blockers, intranasal nitroglycerin spray and ointment, Ganglion blockers.*
AIMS & OBJECTIVES: 1.To compare the efficacy of intravenous bolus dose of Esmolol Hydrochloride versus Lignocaine Hydrochloride to attenuate the hemodynamic responses during general anaesthesia requiring laryngoscopy and endotracheal intubation.
2.To compare the heart rate and systolic, diastolic and mean arterial blood pressures.
CONCLUSION: This study shows the intravenous bolus dose of esmolol hydrochloride 0.5 mg per kg body weight is superior to intravenous lignocaine hydrochloride 1.5 mg per kg body weight IV bolus to attenuate the hemodynamic responses to Laryngoscopy and endotracheal intubation.
Key Words: *ESMOLOL, LIGNOCAINE, LARYNGOSCOPY*

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I. Introduction

There is substantial evidence that laryngoscopy and endotracheal intubation in lightly anesthetized patients are accompanied by a significant increase in heart rate and arterial blood pressure[1] . These changes are usually short duration and well tolerated by patients in the absence of cardiovascular diseases or disturbed intracranial pressure homeostasis[2].

The various, complications observed during endotracheal intubation are arrhythmias, MI, intracranial hemorrhage, acute LVF and pulmonary edema. In eclamptic patients, convulsions may be precipitated. Most of all types of dysrhythmias have been reported in addition to sinus tachycardia and sinus

Various strategies have been applied to attenuate these responses. These include minimizing the duration of laryngoscopy to less than 15 seconds, use of I.V or topical lidocaine, deep inhalational anesthetics, I.V. Narcotics, adrenoceptor blocking agents, vasodilators, calcium channel blockers, intranasal nitroglycerin spray and ointment, Ganglion blockers and avoiding laryngoscopy and resorting to blind nasal intubation.

II. Aims and Objectives

1. The aim of the study is to compare the efficacy of intravenous bolus dose of Esmolol Hydrochloride versus Lignocaine Hydrochloride to attenuate the hemodynamic responses during general anaesthesia requiring laryngoscopy and endotracheal intubation.
2. The aim is to study and compare the heart rate and systolic, diastolic and mean arterial blood pressures.

III. Patients and Methods

The study was conducted on 60 patients of either sex of ASA grade 1 and 2 and Mallampati Grade - I of both sex, in the age group of 18-70 years undergoing various surgical procedures under general anesthesia requiring laryngoscopy and endotracheal intubation, after informed consent.
The patients were randomly divided into two groups, A and B (having 30 patients in each group)

GROUP-A: Comprising of 30 patients, who received esmolol hydrochloride 0.5mg per kg body weight IV bolus administered 60 seconds before laryngoscopy and endotracheal tube insertion.

GROUP-B: Comprising of 30 patients, who received intravenous lignocaine hydrochloride 1.5 mg/kg body weight IV bolus administered 90 seconds before laryngoscopy and endotracheal tube insertion.

All the patients underwent the following investigations viz, complete urine analysis, haemogram, blood chemistry, X-ray chest and a preoperative ECG.

Inclusion criteria

- Age group 18 to 70 years.
- ASA grades 1 and 2,
- Patients posted for surgery under general anaesthesia**.**

Exclusion-criteria:

- Consent not given**.**
- ASA grades 3 and 4.
- Patients with any bleeding disorder and using anticoagulants.
- Patients with the severe respiratory disease.
- Patients with major kidney, liver and heart diseases.
- History of allergy to the any of the drugs used in the study.
- Pregnant women.
- -Anticipated difficult airway

Premedication with midazolam 2mg and glycopyrrolate 0.2 mg IntraMuscularly were given slowly 30 minutes before induction. The patient was connected to non-invasive blood pressure monitor and pulse-oximeter probe and elector cardio graphic leads (limb-lead-II).

All patients were pre-oxygenated with 100% oxygen for 3 minutes, before induction of anaesthesia. Induction was achieved with injection thiopentone sodium 2.5% solution given in a dose of 5 mg/kg body weight. Further sequence varied between the two groups.

In Group-A after induction of anaesthesia with thiopentone sodium was followed by intravenous injection of esmolol hydrochloride 0.5 mg/kg IV bolus, 60 sec before induction.

Then blood pressure and pulse rate were recorded in all patients. This is followed by injection suxamethonium 1.5mg per kg body weight. After 60seconds laryngoscopy was performed by the aid of Macintosh laryngoscope and the patient were intubated with an appropriate oral, cuffed, portex endotracheal tube. The duration of laryngoscopy was within 15-20 seconds. Patients in whom laryngoscopy was difficult or in whom it exceeded 20 seconds were excluded from the study. Patients were then connected with a closed circuit with a circle absorber. Anaesthesia was maintained with nitrous oxide (67%) and oxygen (33%) and nondepolarizing muscle relaxant vecuronium bromide was used in a dose of 0.08 mg per kg body weight in all cases. Heart rate and blood pressure were noted immediately after intubation. All throughout the surgery saturation was maintained at 99%. Surgery was not allowed to commence until the study was completed. At the end of the surgery patients were reversed with injection neostigmine 0.05 mg per kg body weight and injection atropine 0.02 mg per kg body weight.

In Group-B after induction of anaesthesia with thiopentone sodium was followed with an injection of lignocaine hydrochloride (without preservative) 2% in a dose of 1.5 mg per kg body weight, 90 seconds before induction.

Then blood pressure and pulse rate were recorded in all patients. This is followed by injection suxamethonium 1.5 mg per kg body weight. After 60 seconds laryngoscopy was performed and the patient was intubated. Intubation was achieved by the aid of Macintosh laryngoscope. The duration of laryngoscopy was within 15-20 seconds. Patients in whom laryngoscopy was difficult or in whom it exceeded 20 seconds, were excluded form the study. Patients were then connected to and ventilated with a closed circuit with a circle absorber for controlled ventilation anaesthesia. Anaesthesia was maintained with nitrous oxide (67%) and

oxygen (33%) and non-depolarising muscle relaxant vecuronium bromide was used in a dose of 0.08 mg per kg body weight in all cases. Surgery was not to commence till the recordings were completed.At the end of surgery ,residual neuro muscular blockage was reversed with neostigmine(0.05mg/kg)and atropine (0.02mg/kg)

All the patients were followed in the post operative period. No incidence of any adverse effects was seen in the post operative period in the study group. The parameters recorded were:-

1. Heart rate
2. Systolic blood pressure
3. Diastolic blood pressure
4. Mean arterial pressure.

IV. Observations and Results

Sixty patients, undergoing elective, non-cardiac surgery were selected for the study. The patients were randomly divided into two groups, of 30 patients each.

Group – A - Patients received esmolol hydrochloride Group –B - Patients received lignocaine hydrochloride

TABLE COMPARISON OF AGE, WEIGHT, MALE/FEMALE RATIO

Group	Age (yrs)	Weight (kgs)	Male / female
Esmolol (N = 30)	28.27 (18-70)	49.76 (40-60)	10/20
Lignocaine (N = 30)	26.4 (18-70)	47.63 (40-60)	12/18

Tables showing age, weight and sex distribution in both Esmolol and Lignocaine group.The Esmolol group has 10 males and 20 females and Lignocaine group have 12 males and 18 females.The range for ages was 18-70 years in both the groups And the weight range for Lignocaine and Esmolol group was 40 to 60 kgs. There was no statistically significant difference (P>0.05)

V. Parameters Recorded Before Induction

Parameter	Esmolol (n=30)	Lignocaine (n= 30)
Heart Rate	88.10(+1.95)	89(+2.08)
Systolic BP	123.70(+5.12)	120.6(+5.91)
Diastolic BP	79.57(+3.28)	78.10(+4.36)
Mean Arterial pressure	94.23 (+3.67)	92.37(+4.59)

- Values are mean with S.D (standard deviation) in the bracket.
- Tests of significance between group was carried out by Students t-test
- No significant difference was observed between esmolol and lignocaine group values (P>0.05), of any parameters.

Parameter	Esmolol (n=30)	Lignocaine (n= 30)
Heart Rate	91.10(+2.31)	91.4(1.82)
Systolic BP	115.83(+5.19)	110.4(+5.81)
Diastolic BP	76.13(+2.98)	73.77(+4.33)
Mean Arterial pressure	89.63(+3.54)	83.03(+4.01)

TABLE RECORDED VALUES AFTER INDUCTION

- Values are mean with S.D (standard deviation) in brackets
- In both the groups following induction there was a fall in systolic blood pressure, diastolic blood pressure and mean arterial pressures. The Fall is not statistically significant.
- A slight Increase in heart rate was observed. It was not statistically significant (P>0.05)

TABLE RECORDED VALUES AT LARYNGOSCOPY AND INTUBATION

Parameter	Esmolol (n=30)	Lignocaine (n= 30)
Heart Rate	98.10(+2.68)	119.40(+2.28)
Systolic BP	129.3(+4.98)	148.7(+5.54)
Diastolic BP	80.33(+2.15)	90.30(+5.18)
Mean Arterial pressure	97.73(+2.85)	109.40(+4.25)

- The change in parameters when compared between the two are statistically significant(P<0.05
- The above table showing the values of hemodynamic changes at Laryngoscopy and intubation between Lignocaine and Esmolol groups, Though there was an increase in all the parameters in both groups, the increase in parameters , in the Esmolol group was not much significant.
- In Esmolol group the rise in parameters was significantly low(P<0.05)

TABLE RECORDED VALUES AFTER I MINUTE OF INTUBATION

Parameter	Esmolol (n=30)	Lignocaine (n= 30)
Heart rate	95.2(+2.37)	119.8(+2.03)
Systolic BP	126.20(+5.67)	144.2(+4.65)
Diastolic BP	80.13(+2.14)	86.30(+5.03)
Mean arterial pressure	95.30(+3.00)	105.70(+3.99)

- Table showing the values of hemodynamic changes after 1 minute of intubation between Lignocaine and Esmolol groups.
- When the value after 1 minute intubation was compared to the pre-induction values there was rise in values in both groups but the parameters in the Esmolol group were lower compared to Lignocaine group which was statistically significant.(P<0.05)

TABLE RECORDED VALUES AFTER 2 MINUTES OF INTUBATION

Parameter	Esmolol (n=30)	Lignocaine (n= 30)
Heart Rate	91.97(+2.13)	114.5(+2.75)
Systolic BP	125.37(+5.39)	139.9(+6.14)
Diastolic BP	80.07(+2.21)	83.53(+4.93)
Mean Arterial pressure	94.40(+2.98)	101.9(+3.89)

- The above table showing the values of hemodynamic changes after 2 minutes of intubation between Lignocaine and Esmolol groups.
- Attenuation of reflex response was significant in Esmolol Group.(P<0.05)
- In Esmolol group attenuation of reflex response was significant and the values were near the basal recorded values, (P<0.05)

TABLE RECORDED VALUES AFTER 3 MINUTES OF INTUBATION

Parameter	Esmolol (n=30)	Lignocaine (n= 30)
Heart Rate	88.48(+2.02)	103.5(+0.92)
Systolic BP	124.13(+4.99)	128.1(+4.07)
Diastolic BP	79.60(+2.36)	79.43(+3.96)
Mean Arterial pressure	94.37(+2.88)	95.4(+3.15)

- The above table showing the values of hemodynamic changes after 3minutes of intubation between Lignocaine and Esmolol groups.
- In the Lignocaine group parameters did not reach the basal values even after three minutes, in Esmolol group , the values were similar to the basal values, It was statistically significant(P<0.05)

TABLE RECORDED VALUES AFTER 4 MINUTES OF INTUBATION

Parameter	**Esmolol (n=30)**	**Lignocaine (n= 30)**
Heart rate	88.30(+1.87)	99.03(+2.26)
Systolic BP	123.57(+5.22)	126.7(+4.12)
Diastolic BP	79.80(+3.19)	77.7(+3.80)
Mean arterial pressure	93.93(+3.70)	93.67(+2.89)

- The above table showing the values of hemodynamic changes after 4minutes of intubation between Lignocaine and Esmolol groups.
- Parameters did not reach the basal values even after four minutes in the Lignocaine group while in the Esmolol Group the parameters have reached the basal group.
- The changes in parameters when compared between the two group yielded statistical significance for Heart rate and Systolic blood pressure (P<0.05) the other parameters, Diastolic and Mean arterial pressure were statistically insignificant (P>0.05)

TABLE RECORDED VALUES AFTER 5 MINUTES OF INTUBATION

Parameter	**Esmolol (n=30)**	**Lignocaine (n= 30)**
Heart Rate	88.30(+2.02)	93.83(+1.95)
Systolic BP	123.47(+5.19)	120.6(+5.74)
Diastolic BP	79.97(+3.34)	77.67(+4.19)
Mean Arterial pressure	94.00(+3.66)	91.13(+4.37)

- In Esmolol Group values were similar to the basal values and no significant changes were observed after 5 minutes of intubation, and the values of Lignocaine Group also approached basal value
- However, the changes in parameters when compared between two groups were statistically significant(P<0.05)

VI. Discussion

Reflex changes in the cardiovascular system after laryngoscopy and intubation are most marked. They manifest themselves in the form of tachycardia, hypertension, and cardiac arrhythmias, ectopics being most common.

Reflex cardiovascular effects of laryngoscopy and intubation in anaesthetized patients have been described previously and include a pressor response and tachycardia despite the increase in systemic arterial pressure **(King et al., 1951)[1].**Hypertension and tachycardia are common responses in normotensive patients (**PRYS Roberts et al., 1971; Fox et al, 1977;**)[3].

Although the direct recording of sympathetic nervous activity is difficult in man, measurements of plasma concentration of catecholamines have consistently demonstrated increased nor-adrenaline following laryngoscopy **(Russel et al, 1984**)[4] and so confirmed sympathetic mediation in this response.

The cardiovascular changes and catecholamine discharge are seen during laryngoscopy and tracheal intubation appear in two phases. The effects of laryngoscopy should be distinguished from effects seen while the endotracheal tube is placed through the trachea (**SHERMAN et al**)[5] showed the differences between these two events.

Postintubation response has been associated with ST-segment changes, ventricular arrhythmias, pulmonary edema, and ruptured cerebral aneurysm. In hypertensive patients, this hyper dynamic response is exaggerated and undoubtedly causes a large increase in myocardial oxygen demand. In fact, the anaesthetic stress can induce myocardial ischemia. Some authors in fact, consider the intubation period, one of the periods of greatest risk in surgical patients with coronary artery disease. It may also be dangerous in increased intracranial pressure.

Abou-Madi et al[6] have discussed the possible mechanisms to account for these observations with IV lignocaine. These include a direct myocardial depressant effect, a peripheral vasodilating effect and finally an effect on synaptic transmission.

Lev and Rosen[7] wrote a review on "Prophylactic lignocaine use preintubation". They said that a dose of prophylactic lignocaine of 1.5 mg/kg given intravenously 3 minutes before intubation is optimal. No studies document any harmful effects of prophylactic lignocaine given preintubation.

Bachofen[8] studied blood pressure responses to endotracheal intubation with 1.5 mg/kg lignocaine in patients with intracranial vessel malformations or brain tumors. In both groups, no significant effect of lignocaine on the pressure response could be observed.

Chraemmer-Jorgensen et al (1986)[9]found no beneficial effect when lignocaine 1.5mg/kg body weight was given 2 min prior to laryngoscopy.

S J WARREN (1990)[10] found that lignocaine 1.5mg/kg body weight given more than 3 mins before laryngoscopy failed to attenuate the pressor response

Esmolol is a beta-blocking agent with several desirable properties. The factors favoring esmolol in obtunding the pressor response to laryngoscopy include. It is relatively cardioselective, ultra-short acting, with rapid onset of action. **(VUCEVIC et al 1991)**[11]**;**

Adjusting bolus dose of esmolol for body weight is not likely to be necessary (**Anthony L Sintelos 1987**)[12]. The rationale for administering esmolol as a bolus is not only to treat transient increases in heart rate and blood pressure, but also to prevent heart rate values from reaching the ischaemic threshold in the predisposed patients.

Shane Sheppard, Chris J. Eagle, Leo Strunin[13] used esmolol as a bolus for control of hemodynamic response to intubation. The bolus dose of esmolol was administered in two groups. One group received 100 mg and the other group 200 mg. in their study adequate hemodynamic control was observed following administration of 200 mg bolus dose of esmolol.

In our study, we concluded that bolus dose of esmolol (0.5mg per kg body weight) given intravenously, provided consistent and reliable protection from increases in both heart rate and systolic blood pressure during and after intubation, compared to lignocaine hydrochloride (1.5 mg per kg body weight) IV bolus.

The pre-induction hemodynamic values difference was not statistically significant.Following induction with thiopentone, there was a slight fall in systolic and diastolic blood pressure and a slight fall in the heart rate. This was not statistically significant.

The hemodynamic parameters were found to be increased at laryngoscopy and intubation in both Lignocaine and Esmolol groups. The increase in the parameters in the Esmolol group was not as much as in the Lignocaine group. It was statistically significant.Observations at one minute after intubation revealed that the hemodynamic parameters were significantly higher in the Lignocaine group. In the Esmolol group, the values were not significantly increased than basal values. It was statistically significant.Observations at 2^{nd} and 3^{rd} minutes after intubation showed that the values in the Lignocaine group were still higher than in the Esmolol group. The values in the Esmolol group were close to the basal values.Observations at a fourth minute after intubation showed that the values were still high in Lignocaine group, compared to basal recordings. In Esmolol group the parameters were similar to basal recordings. The difference of, diastolic and mean arterial pressures were statistically insignificant ($p > 0.05$)

Observations at the five minutes after intubation showed that the values were similar to basal recordings in both Lignocaine and Esmolol groups, there was the statistically significant difference.

Oxorn D, JWD Knon and Jereny Hill[14] have used esmolol as a single bolus of 100 mg and 200 mg in a double-blind fashion. The systolic blood pressure post-intubation was lower in the Esmolol 200 mg group ($p < 0.05$). They summarised that Esmolol 200 mg was effective in mitigating the hemodynamic response to tracheal intubation.

Results of the present study are consistent with the above studies in attenuating hemodynamic responses to laryngoscopy and intubation by the use of intravenous bolus dose of 0.5 mg per kg body weight of esmolol is superior to lignocaine hydrochloride 1.5 mg per kg body weight IV bolus.

VII. Conclusion

This study shows the intravenous bolus dose of esmolol hydrochloride 0.5 mg per kg body weight is superior to intravenous lignocaine hydrochloride 1.5 mg per kg body weight IV bolus to attenuate the hemodynamic responses to Laryngoscopy and endotracheal intubation.No side effects were noted with esmolol and lignocaine hydrochloride.It establishes the usefulness of intravenous bolus dose of esmolol to attenuate the hemodynamic responses to laryngoscopy and endotracheal intubation.

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