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Original Research Paper

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A STUDY OF THE EFFICACY OF INTRAVENOUS BOLUS DOSE OF ESMOLOL HYDROCHLORIDE FOR ATTENUATION OF HAEMODYNAMIC RESPONSES TO LARYNGOSCOPY AND ENDOTRACHEAL INTUBATION DURING GENERAL ANAESTHESIA

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ABSTRACT

Background: Laryngoscopy and tracheal intubation is invariably associated with a reflex sympathetic pressor response resulting in elevated heart rate and blood pressures. This may prove detrimental in high-risk patients. Objective of this study was to compare the effects of 1mg/kg i.v bolus dose of Esmolol in attenuation of this response.

Methods: 70 ASA I - II status normotensive patients scheduled for elective surgical procedures were selected randomly and divided into two groups of 35 each. After premedication just before induction the study drug was given intravenous in 15-20 seconds. Thereafter, inducing the patient with Propofol and Succinylcholine following pre-oxygenation; mask ventilation started for 4 minutes and then act of laryngoscopy and endotracheal intubation were performed in a smoothest possible manner and as quickly as possible. The anaesthesia was maintained with 50% of oxygen in Nitrous oxide, Isoflurane and Vecuronium bromide. The heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure and rate pressure product along with arrhythmia if any, recorded just before induction, at the time of intubation and 1, 3 and 5 minutes after intubation in both the group of patients. The result obtained was then studied and analyzed with statistical reference they were compared.

Results: After intubation incidence of tachycardia was significantly greater in control group than in Esmolol group. Rise in SBP, DBP, RPP were also statistically significant in control group than in esmolol group.

Conclusion: Attenuation of pressor response is seen with Esmolol. Esmolol 1mg/kg i.v. bolus provides a consistent, reliable and effective attenuation.

KEYWORDS : Laryngoscopy, Intubation, Esmolol

INTRODUCTION

Airway management is the utmost important during delivery of General Anaesthesia. Patients who have been anaesthetized are unable to maintain an adequate airway on their own and artificial airway maintenance devices are employed. The most important discovery that completely revolutionized general anaesthesia was the development of endotracheal anaesthesia by Ivan W. Magill and E. Stanley Rowbotham in 1921.

King et al. (1951)[1] described the circulatory responses to laryngeal and tracheal stimulation following laryngoscopy and tracheal intubation as reflex sympatho-adrenal stimulation. **Charles Wyecoff (1960)**[2] found that there was significant increase in arterial blood pressure and heart rate following laryngoscopy and intubation.

Even though the elevation in blood pressure and heart rate due to laryngoscopy and intubation are transient, (little more than 10 min) (**Basu and Pramanik, 1988**[3]) they may have detrimental effects in high risk patients including myocardial infarction, cardiac failure, intracranial hemorrhage and increases in intracranial pressure. [**Shribman AJ, Smith G, Achola KJ** 1987][4]

Many strategies have been advocated to minimize these hemodynamic adverse responses including minimizing the duration of laryngoscopy to less than 15 seconds and aimed at different levels of the reflex arc

- **Block of the peripheral sensory receptors and afferent input** – topical application and infiltration of local anaesthetic to superior laryngeal nerve.4% lignocaine spray.
- **Block of central mechanism of integration and sensory input** – fentanyl, morphine etc.
- **Block of efferent pathway and effector sites** i.v. lignocaine, **β** blockers, calcium channel blockers, hydralazine etc.

But no single drug or technique is 100% efficient. Recommendations for attenuating the reflex hypertension and tachycardia are therefore manifold.

In 1990 ESMOLOL was studied in detail by **Sheppard S et al**[5]. It is an ultra-short acting, cardio selective drug, whose half-life is 9 min and has few to no side effects.

OBJECTIVES

The study of administration of i.v bolus Esmolol before laryngoscopy and tracheal intubation was carried out to observe the variations in haemodynamic responses (Heart rate and blood pressure) to laryngoscopy and intubation, to observe the effects of intravenous bolus dose (1mg/kg) of Esmolol hydrochloride on haemodynamic responses to laryngoscopy and endotracheal intubation, to compare the effect of intravenous bolus dose of Esmolol hydrochloride on haemodynamic responses to laryngoscopy and endotracheal intubation with a control group, to observe the occurrence of adverse effects if any.

MATERIAL AND METHODS

After approval from the institutional ethical committee and informed written consent the study was conducted carried out as a randomized controlled double-blind design, in the Department of Anesthesiology, Rajendra Institute of Medical Sciences (R. I. M. S), Ranchi. Seventy patients were selected for this study. They were of both sexes, age ranged from 20-65 years, weight ranged from 50- 70 kg, and American Society of Anaesthesiologist (ASA) classification and were in the grade of I and II. All patients were randomly divided into two groups of 35 persons in each group, by randomized, double blind method by closed envelope system.

Group C (Control) patients received 10 ml of normal saline IV 2 minute before induction as a control.

Group E (Esmolol) patients received Esmolol 1 mg/kg (with normal saline to make 10 ml).

On arrival at operation theatre standard anaesthesia monitors including electrocardiogram (ECG), non-invasive blood pressure (NIBP) and pulse oximetry were attached and hemodynamic parameters were recorded. An intravenous drip Ringer Lactate was set up before induction of anaesthesia. Glycopyrrolate 0.2 mg IV, inj. Ranitidine 50 mg IV, inj. Metoclopramide 10 mg IV, and inj. Butrophanol 1 mg IV just before induction. After pre-oxygenation with 100% oxygen for 5 minutes, induction in all cases were done by Propofol (2.5 mg/Kg IV slowly). After induction of anaesthesia hemodynamic variables were recorded. Later 60 sec after loss of consciousness which was confirmed by inability to respond to verbal commands and loss of eyelash reflex, inj. Succinylcholine (1.5 mg/kg IV stat) was administered and when no responses obtained to the train of four (TOF) stimuli with the TOF-guard device. Laryngoscopy and oro-tracheal intubation were done. Duration of laryngoscopy was kept less than 20 seconds. Trachea was intubated with adequate size endotracheal tube (ET). Following successful placement of endotracheal tube, patients was put on IPPV and maintained by Isoflurane (1-1.5%) and equal mixtures of Oxygen-Nitrous Oxide (4 L/min). Bolus dose of Vecuronium (0.08 mg/Kg IV) initially followed with intermittent bolus dose of Vecuronium (0.02 mg/Kg IV) was administered.

At the end of the surgery residual neuromuscular block was antagonized with inj. Neostigmine (0.05 mg/Kg, IV) and inj. Glycopyrrolate (0.01mg/Kg, IV). Extubation was performed when responses were obtained to the TOF stimulus, adequate respiration and able to obey verbal commands. Any other anaesthetics and narcotic drugs for maintenance were introduced only after study period.

The above-mentioned parameter was noted at the following specific stages in both the groups

- Immediate preoperative, before administration of any drugs (base line value).
- At the time of intubation
- One minute, 3 min, 5 min, 10 min, 20 min, 30 min, 40 min, 60 min and every 10 min after laryngoscopy and intubation

Results obtained in the study were presented in a tabulated manner (mean $\pm$ SD) in the following section of results and analysis. Statistical analysis was done by unpaired 't' test between the groups, repeated measure ANOVA test within the group and Chi square test for non-parametric data, where sample mean was used to estimate the population mean and the corresponding p value were obtained ($p<0.05$ was considered as significant and $p<0.01$ was considered as highly significant whereas, $p> 0.05$ was considered as statistically insignificant). Demographic data were expressed in tabular manner and also with bar diagram. Change of different variables (e.g. heart rate, systolic blood pressure, diastolic blood pressure, rate pressure product) with time is displayed in graphical format.

OBSERVATIONS AND RESULTS

Table-1

Variables	Group C (n = 35)	Group E (n = 35)
Weight	57.8 $\pm$ 4.71	58.14 $\pm$ 5.44
ASA Gradel/II	35	35
Age	37.37 $\pm$ 11.60	38.62 $\pm$ 11.64
Sex	0.75:1	

In our study, the demographic data regarding age, sex, weight and ASA physical status were comparable.

Table-2 Percentage of mean heart rate increase (+) or decrease (-) in comparison to basal level (time 1)

Time	Time 2 (Intubation)	Time 3 (1 min)	Time 4 (3 min)	Time 5 (5 min)
Group C	20.90	26.63	12.5	8.3
Group E	5.8	7.8	5.9	3.6

Table 2 shows: An increase in heart rate was maximum in both groups at 1 minute after laryngoscopy and intubation. Thereafter, there was a gradual decrease in heart rate in both the groups. Magnitude of increase in heart rate was higher in control group as compared to Esmolol group.

Table-3 Percentage of mean systolic blood pressure increase (+) or decrease (-) in comparison to basal level (time 1)

Time	Time 2 (Intubation)	Time 3 (1 min)	Time 4 (3 min)	Time 5 (5 min)
Group C	10.49	13.38	6.0	3.58
Group E	- 1.4	0.7	1.09	-0.78

An increase in SBP was maximum in both the groups at 1 min after laryngoscopy and intubation. Thereafter, a gradual decrease in SBP in both the group started. In Esmolol group it was even lower than basal value at the time of intubation and it was higher than basal value in control group. The magnitude of increase was higher in control group at all time point after intubation than Esmolol group.

Table-4 Percentage of mean diastolic blood pressure increase (+) or decrease (-) in comparison to basal level (time 1)

Time	Time 2 (Intubation)	Time 3 (1 min)	Time4 (3min)	Time 5 (5 min)
Group C	9.85	19.91	8.36	1.75
Group E	- 1.03	2.45	1.48	0.10

Table 4 display maximum increase in DBP in both the groups at 1 min after laryngoscopy and intubation. Then a gradual decline in DBP in both Groups starts. In Esmolol group it was even lower than baseline at the time of intubation as compared to control group. Magnitude of increase in DBP in control was higher than Esmolol at all point of time after intubation.

Table-5 Percentage of mean Blood Pressure (MBP) increase (+) or decrease (-) in comparison to basal level (time 1)

Time	Time 2 (Intubation)	Time 3 (1 min)	Tim4 (3min)	Time 5 (5 min)
Group C	10.16	16.37	7.1	2.1
Group E	- 1.7	1.1	1.17	0.54

Table 5 shows maximum increase in MBP in both the groups at 1 min after laryngoscopy and intubation, then, a gradual declining towards baseline start in both groups & it becomes lower than the basal value in Esmolol group at 5 min after intubation. Magnitude of increase was higher in control as compared to Esmolol group at all time point after intubation.

Table-6 Percentage of mean Rate Pressure Product (RPP) increase (+) or decrease (-) in comparison to basal level (time 1)

Time	Time 2 (Intubation)	Time 3 (1 min)	Time 4 (3 min)	Time 5 (5 min)
Group C	35.41	40.95	17.88	11.46
Group E	3.28	8.37	7.1	4.58

Table 6 displays maximum rise in RPP in both the groups at 1 min after laryngoscopy and intubation, thereafter, a gradual decrease in RPP in both the groups. Magnitude of increase in RPP was higher in control group as compared to Esmolol at all point of time after intubation.

SIDE EFFECTS AND COMPLICATIONS

In both Group C and Group E there was no incidence of any side effects and complications.

DISCUSSION

The maximum percentage increase in heart rate was 26.63 % in control group and 7.8% in Esmolol group as compared to basal value (1 minute after intubation, table 2). Similar findings were seen by study of Rathore et al., 2002[7], and MS Ghaus et al., 2000[6], as in our study.

The maximum percentage increase in mean systolic blood pressure was 13.38 % in control group, while, it was 1.09 % in Esmolol group as compared to basal value at 1 minute after intubation. (Table3). Similar finding of attenuation in systolic blood pressure was observed by study of Rathor et al., 2002[7], who showed Esmolol attenuated the systolic blood pressure significantly as compared to control group.

The maximum percentage increase in mean diastolic blood pressure was 19.91 % in control group, while, it was only 2.45% in Esmolol group as compared to basal value at 1 minute after intubation (Table 4). The above findings are similar as studied by MS Ghaus et al., 2000[6]; they showed that diastolic blood pressure was significantly attenuated by Esmolol group as in our study.

The maximum percentage increase in mean blood pressure was 16.37 % in control group, while, it was only 1.17% in Esmolol group as compared to basal value at 1 minute after intubation (Table5). The above findings are similar to study done by M S Ghaus et al 2000[6], who showed, significant attenuation of mean blood pressure by Esmolol as compared to control group ($p < 0.01$).

The maximum percentage increase in rate pressure product was 40.95 % in control group, while, it was 8.37% in Esmolol group as compared to basal value at 1 minute after intubation (Table 6). These findings are same as study done by MS Ghaus et al., 2002[6], who showed significant ($p < 0.01$) attenuation of rate pressure product by Esmolol group.

Arrhythmias: Our study could not detect any type of arrhythmias at any time point, at and after intubation in both the groups

CONCLUSION

From the above discussion following conclusions obtained: Esmolol was effective in attenuating the increase in heart rate, systolic, diastolic, mean blood pressure and rate pressure product (a measure of myocardial oxygen demand) response after laryngoscopy and endotracheal intubation. Therefore, Esmolol can be used to attenuate the heart rate, blood pressure and rate pressure product before laryngoscopy and endotracheal intubation.

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