

Comparative Effects of Lidocaine and Esmolol in Modifying the Hemodynamic Response to Laryngoscopy and Intubation

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ABSTRACT

Aim: To compare the safety and efficacy of lidocaine and esmolol, in modifying the hemodynamic response to laryngoscopy and intubation.

Design: Randomized, placebo-controlled, double-blind study was carried out in Fauji Foundation hospital Lahore from 1st June 2012 to 31st August 2012, after taking written informed consent from patients and permission from medical and ethical committee of hospital.

Patients & methods: 60 ASA physical status I and II patients undergoing elective surgery with general endotracheal anesthesia. Anesthesia was induced with propofol 2.5 mg/kg, and intubation was facilitated with atracurium 0.5 mg/kg. Isoflurane (0.5% to 1%) and 50% nitrous oxide in oxygen were used for maintenance of anesthesia. In addition, patients received one of the following study drugs intravenously prior to laryngoscopy: Group 1 (control) = saline 5 ml; Group 2 = lidocaine 1.5 mg/kg; Group 3 = esmolol 1.5 mg/kg; Mean arterial pressure (MAP) and heart rate (HR) were recorded every minute for 20 minutes following induction of anesthesia after laryngoscopy and intubation. MAP increased significantly in all three treatment groups (control 47% +/- 15%, lidocaine 34% +/- 9%, esmolol 11% +/- 5 %,) compared with preinduction baseline values. In the esmolol-pretreated patients, the increase in HR was significantly lower (8% +/- 3%) compared with lidocaine (41% +/- 8%), and control (47% +/- 4%) groups.

Conclusions: Lidocaine 1.5 mg/kg I.V was less effective in controlling the acute hemodynamic response following laryngoscopy and intubation. Esmolol 1.5 mg/kg I.V was significantly more effective than lidocaine in controlling the HR response to laryngoscopy and intubation (p <0.05). Esmolol also was significantly more effective than lidocaine in minimizing the increase in MAP (25% vs. 55%).

Keywords: Esmolol; hypertension; intubation, Intratracheal-cardiovascular responses; laryngoscopy;

INTRODUCTION

Although there are many new airway devices in common use but rigid laryngoscopy and tracheal intubation still remain the gold standard in airway management. The hemodynamic changes occurring from airway instrumentation are due to sympathoadrenal discharge caused by epipharyngeal and parapharyngeal stimulations. There is increase in heart rate (HR), blood pressure, intraocular, and intracranial pressure. The arterial hypertension is due to increase in cardiac output rather than an increase in systemic vascular resistance, and is associated with the transient rise in central venous pressure. Arrhythmias can also occur. Usually these changes are well tolerated by healthy individuals.

The major conditions in which these responses show serious challenges are cardiovascular diseases like hypertension, coronary artery disease, aneurysmal vascular disease or those with decreased

intracranial compliance like head injury with extra or intradural hematoma formation, intracranial tumors, etc. A sudden rise in blood pressure may cause left ventricular failure, myocardial ischemia, and cerebral hemorrhage. These complications are more likely in the presence of coronary or cerebral atheroma or hypertension. Also convulsions may be precipitated in pre-eclamptic patients.

Hemodynamic response to laryngoscopy and intubation was first described by Reid and Brace¹. In 1940. The rise in the pulse rate and blood pressure is usually transient, variable and unpredictable. Various attempts have been made to suppress this pressor response. The pharmacological methods are aimed at efferent, afferent, or both limbs of response e.g. volatile inhalational agents², lidocaine³, opioids⁴, sodium nitroprusside⁵, nitroglycerine⁶ calcium channel blockers⁷, and adrenergic blockers⁸. Most workers have used esmolol⁹⁻¹³ (cardioselective beta blocker) as a bolus and in infusion and found it to be effective.

The present study was conducted to see the efficacy of intravenous bolus esmolol (1.5mg/kg), as compared to lidocaine (1.5mg/kg) in attenuating these responses.

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MATERIALS AND METHODS

Following approval from the hospital committee constituted for this purpose and a written informed consent from patients this prospective randomized double blind study was carried out on 60 ASA I and II patients, aged 18-65 years, scheduled for elective surgery requiring general anesthesia with endotracheal intubation (ETI) in Fauji Foundation hospital Lahore. After taking thorough history following Patients were excluded from study

1. Patients on drugs affecting autonomic nervous system,
2. Significant medical co-morbidities,
3. ASA III and above,
4. Known allergies to study drugs,
5. Airway abnormalities,
6. Expected difficult intubation and
7. Patients undergoing procedures requiring head/neck manipulations,
8. Nasogastric tube insertion,
9. Throat packing during study period

Patients were randomly divided into three groups according to computer generated randomization table.

Group L: lidocaine 1.5mg/kg diluted in 10ml normal saline;

Group C: Control 10 ml normal saline.

Group E: Esmolol 1.5 mg/kg in 10 ml normal saline

Person X (Dr Rashid) injected study drug as per study protocol.

Person Y (Dr Tariq Saeed) monitored heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) with respect to time,

Person Z (Dr Nasrullah Khan) intubated the patient (Person Z was kept constant throughout the study).

(Person Y and Z were kept unaware of the drug injected.)

All patients were given 0.2mg Glycopyrrolate bromide intramuscularly 30 min prior to surgery. Inside operating room, after applying routine noninvasive monitors (electrocardiogram/pulse oximeter/non-invasive blood pressure monitor) intravenous access was secured and infusion of ringer lactate 5ml/kg/hr was started.

At minute 0, midazolam 0.04mg/kg along with 0.08mg/kg nalbuphine was administered intravenously over 30 seconds as premedication. At minute 5, study drug (lidocaine 1.5 mg/kg or saline or esmolol 1.5 mg/kg) as per group was injected over 20 seconds in double blinded fashion. Then the patient was oxygenated with 100% oxygen. At minute 7, intravenous propofol 2mg/kg was administered in incremental doses until loss of eyelash reflex occurred. This was followed by inj. atracurium 0.5mg/kg over 20 seconds. Patients were then

ventilated with 60% N₂O in Oxygen up to minute 10. Then at minute 10, patients were intubated. Tube was fixed and secured. After minute 15 only, surgery was allowed to commence.

There after anesthesia was maintained with 60%N₂O + 0.5% isoflurane in 40% oxygen. Hemodynamic parameters monitored were HR, SBP, DBP and MAP. These were measured by putting non-invasive blood pressure monitor (NIBP) on manual mode at that particular time and recorded at min 0(baseline), min 5(prior to injection of study drug), min 7(post study drug), min 10(at intubation), and every minute thereafter for 5 minutes and then at every 5 minutes.

We had defined following parameters for study: 1) Hypotension was defined as SBP<25% of baseline value or 90 mm Hg, whichever was lower; 2) Hypertension was defined as SBP >25% of baseline value or 150mm Hg whichever was higher; 3) Tachycardia was defined as HR >25% of baseline value; 4) Bradycardia was defined as HR<60 beats/min; 5) An arrhythmia was defined as any ventricular or supra-ventricular premature beat or any rhythm other than sinus. Incidences of all these parameters were recorded in all three groups.

If there will be hypotension as per definition in between 10 to 15 min, then fluid challenge will be given. If there will be hypertension as per definition in the above period isoflurane will be started. If there will be tachycardia associated with hypotension, fluid challenge will be given or if associated with hypertension, then isoflurane will be started. If there will be bradycardia as per definition in above period that will be treated with injection Atropine. After 15 minutes, if there will be hypotension, isoflurane will be shut off; if it remained persistent intravenous fluid challenge will be given. If there will be hypertension, isoflurane will be started or increased in incremental doses, still if persisted, bolus dose of injection labetalol 0.5-2 mg/kg will be given.

Data were analyzed using repeated measures of analysis of variance and student's paired t-test for evaluating changes within groups; an unpaired t-test with Bonferroni's correction was used for comparison between treatment groups. A p-value less than 0.05 was considered statistically significant.

RESULTS

Table 1: Mean Age, body weight and sex of patients in the three groups. No significant difference in mean age, weight and sex ratio in the three groups. Heart rate increased significantly in group C and group L, 1 min after intubation ($p < 0.01$) and increased further 3 and 4 min after intubation ($p < 0.001$). In group E the changes in heart rate following intubation were statistically not significant (Fig 1). Five minutes after

the start of infusion and just before intubation systolic blood pressure decreased in all the three groups but the change was statistically significant in group E ($p < 0.01$). Following intubation it increased significantly, 1, 3 and 5 minutes after intubation in group C and group L ($p < 0.001$). In group E systolic blood pressure did not increase following intubation (Fig. 2). There was a significant rise in diastolic blood pressure, 1 and 3 minutes after intubation in group C

and group L ($p < 0.01$). Diastolic blood pressure did not change significantly in group E (Fig. 3). Mean arterial pressure increased significantly in group C and group L following intubation after 1 min ($p < 0.01$) and after 3 and 5 min (< 0.001). In the group E mean arterial pressure decreased significantly ($p < 0.05$) 1 minute after intubation. It increased subsequently but was not significantly different from the initial value (Fig.4).

	Group C	Group L	Group E
Age	37.21± 10.11	38.12±12.14	34.22±14.22
Body weight	66.24±6.28	64.42±4.22	68.42±8.42
Sex ratio	17:3	13:7	11:9

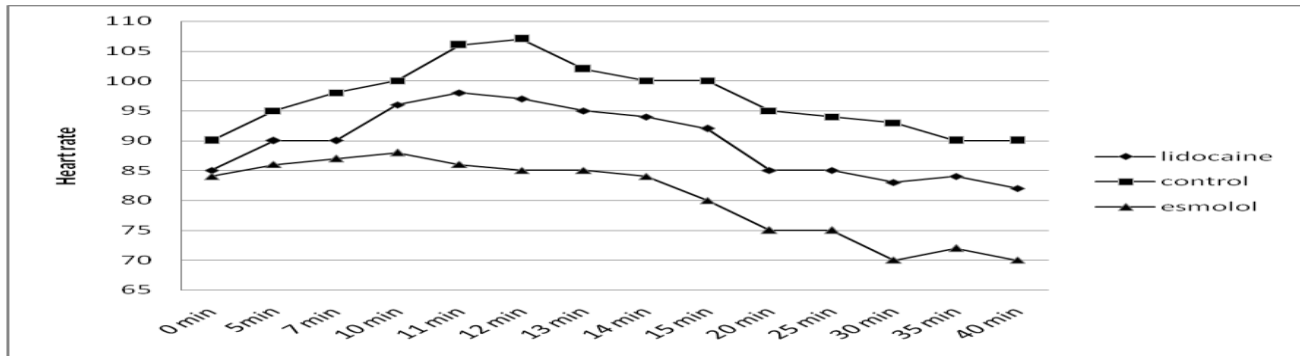


Fig 1: Heart Rate per minute

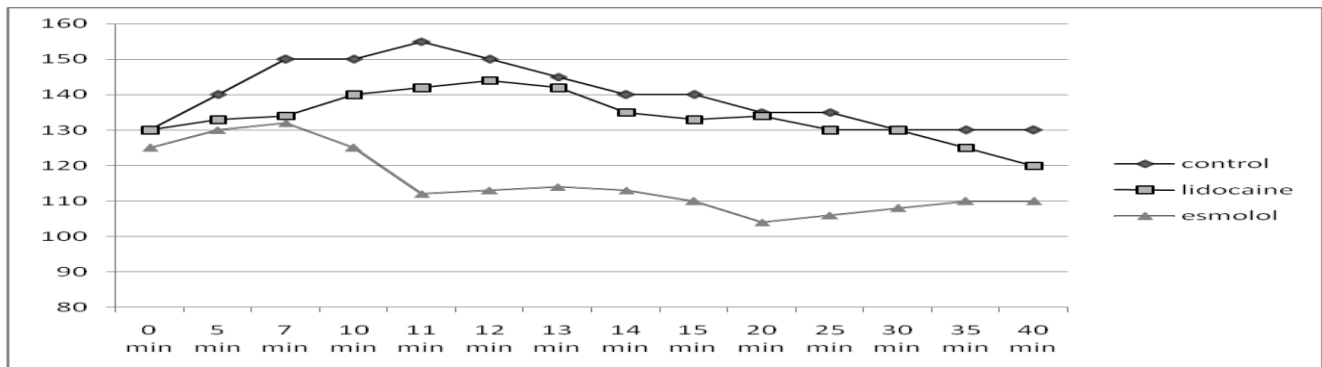


Fig.2: Systolic Blood Pressure

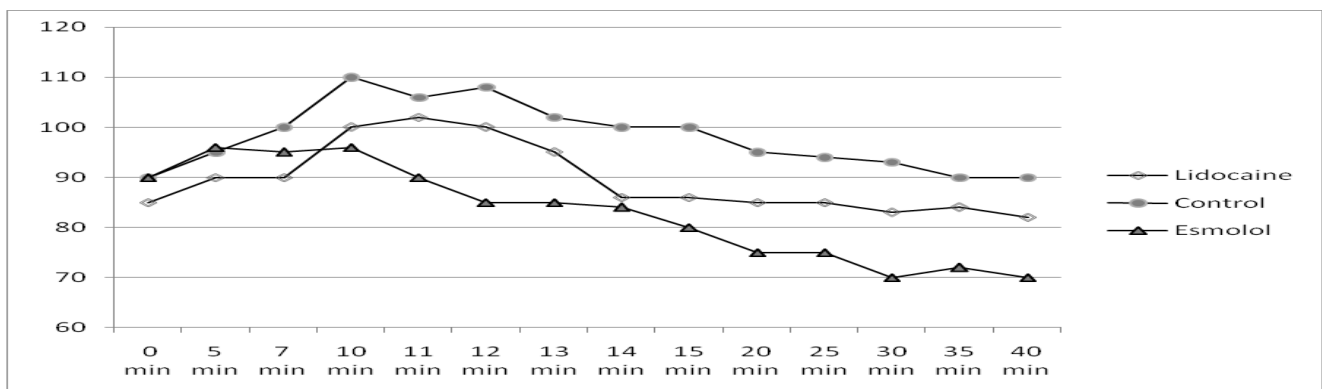


Fig. 3: Diastolic Blood Pressure

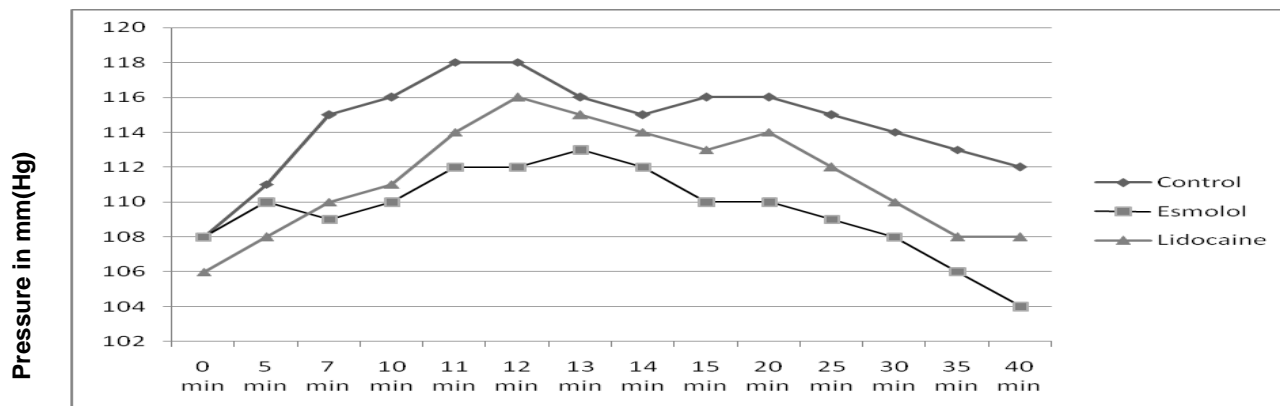


Fig.: Mean Arterial Pressure

DISCUSSION

Rigid laryngoscopy and Endotracheal intubation always leads to a cardiovascular response of elevated blood pressure and heart rate, occasional dysrhythmias, cough reflexes, increased intracranial pressure, and increased intraocular pressure. If specific measures are not taken to prevent hemodynamic response, the HR can increase from 26%-66% depending on the method of induction^{14,15,16,17} and SBP can increase from 36%-45%^{16,17}. In our study also there was 44% rise in HR and 26% rise in SBP in control group. In patients with ischemic heart disease, intracranial lesions, and potential penetrating eye injuries, these responses to intubation are of greater risk. About half the patient with coronary artery disease experience episodes of myocardial ischemia during intubation when specific care is not undertaken.

Various studies have shown the effect of lidocaine to blunt these responses. It can be used in various forms like viscous lidocaine¹⁸, aerosol¹⁹, orolaryngeal spray before the induction of anesthesia^{20,21}, and inhalation of lidocaine prior to induction of anesthesia²².

In some studies it has been observed that use of intravenous lidocaine helps in blunting rises in pulse, blood pressure, intracranial and intraocular pressure. Yukioka et al²³ showed that Cough reflex was suppressed completely by IV lidocaine. Aouad et al²⁴ showed that supplementing sevoflurane induction of anesthesia in children with IV lidocaine 2mg/kg can suppress cough after tracheal intubation and thus improve intubating conditions. In addition, lidocaine minimizes blood pressure fluctuations after tracheal intubation.

Abou-Madi et al²⁵ have discussed the possible mechanisms to account for these observations with IV lidocaine. These include a direct myocardial

depressant effect, a peripheral vasodilating effect and finally an effect on synaptic transmission. Lev & Rosen²⁶ wrote a review on "Prophylactic lidocaine use preintubation". They said that a dose of prophylactic lidocaine of 1.5 mg/kg given intravenously 3 minutes before intubation is optimal. No studies document any harmful effects of prophylactic lidocaine given preintubation.

Recent studies, however, have questioned lidocaine's efficacy. Singh et al's¹⁵, van den Berg et al's²⁷ and Kindler et al's²⁸ study shows that IV Lidocaine 1.5mg/kg was ineffective in controlling the acute hemodynamic response following laryngoscopy and intubation. In two different studies, it was shown that lidocaine 1.5 and 2mg/kg is ineffective in blunting the responses during rapid sequence induction^{17, 29}. Bachofen³⁰ studied blood pressure responses to ETI with 1.5mg/kg lidocaine in patients with intracranial vessel malformations or brain tumors. In both groups no significant effect of lidocaine on the pressure response could be observed.

Bruder et al³¹ in a review article wrote that in clinical practice, lidocaine is particularly effective in preventing the pressor response to tracheal intubation, whatever its route of administration (intravenous or intratracheal), but not the increase in heart rate.

Louizos et al³² used esmolol in microlaryngeal surgery and found it effective in blunting hemodynamic response in smokers. Ugur B et al³³, Hussain Am et al³⁴, shobhana Gupta et al³⁵, Singh SP et al³⁶, Min JH et al³⁷ also in their studies found esmolol very effective.

In our study, in lidocaine group there was significant rise in SBP for 3 minutes after ETI; SBP increased up to 12%; and significant rise in HR was also present for 5 minutes after ETI; HR increased up to 16%. We injected 1.5 mg/kg lidocaine intravenously 5 minutes before intubation. Beta-

blockers with bradycardic, antihypertensive, antiarrhythmic and antiischaemic properties have been advocated. As opposed to lidocaine, these agents are more effective in preventing the changes in heart rate than the pressor response. Esmolol is cardioselective beta blocker with short duration of action; therefore it is commonly used in blunting the hemodynamic response to laryngoscopy and ETI. Most workers have used esmolol^{9,13} (cardioselective beta blocker) as a bolus and in infusion and found it to be effective.

We also selected Esmolol for study in comparison with Lidocaine and found that, in response to laryngoscopy and ETI, HR increased in all the three groups. In the control group 80% patients had tachycardia after intubation and the peak rise of 43.68% was seen at intubation which persisted even after 10 minutes, indicating need for some method to attenuate this response. No adverse effects were seen in these patients, mostly because all the patients were of ASA I class. But, in patients with ischemic heart disease, with fixed cardiac output states, sudden tachycardia associated with laryngoscopy and intubation can cause adverse effects. The esmolol and lidocaine were effective in attenuating rise in HR; the peak rise in the HR being 5.46% and 16.23% in esmolol and lidocaine groups, respectively.

At intubations, 50% patients in control group suffered from hypertension, which was uneventfully corrected by using incremental doses of isoflurane. In patients with hypertension or intracranial pathology, this hypertensive response may cause adverse consequences. Esmolol is very effective in controlling this response of rise in blood pressure also. Although the lidocaine group showed lesser rise in SBP (30.1%) for shorter time (3 minutes) as compared to Control group (47.8%) (10 minutes) but it was much lesser with esmolol (12.24%). AP is a derived value and is important in relation to the auto-regulatory responses of the heart, brain and kidneys. After ETI, the MAP increased by 40%, 25% and 11% in control, lidocaine and esmolol groups respectively from baseline.

CONCLUSION

In conclusion, given 5 minutes prior to intubation, lidocaine (1.5 mg/kg) and esmolol (1.5 mg/kg) both attenuated the rise in pulse rate, though esmolol was better. Lidocaine attenuated the rise in blood pressure with intubation whereas esmolol prevented it maximally. Therefore it can safely be said that esmolol 1.5 mg/kg is superior to lidocaine (1.5 mg/kg) for attenuation of haemodynamic response to laryngoscopy and endotracheal intubation.

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