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Original Research Paper

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COMPARING LOW DOSES OF INTRAVENOUS ESMOLOL, LABETALOL AND LIGNOCAINE FOR ATTENUATION OF HAEMODYNAMIC RESPONSE TO LARYNGOSCOPY AND ENDOTRACHEAL INTUBATION

Dr. Swasthika Vondivillu	Junior Anaesthesia Consultant, Prashanth Hospital
Dr. Shivendra Kumar*	Junior Resident, Dr. D Y Patil School Of Medicine and Hospital, Navi Mumbai. *Corresponding Author
Dr. Asmita Shrivastava	Junior Resident, Dr.D Y Patil School Of Medicine and Hospital, Navi Mumbai.
Dr. Jayshree Vaswani	Professor, Dr.D Y Patil School Of Medicine and Hospital, Navi Mumbai
Dr. Fayaz M Sultan	Senior Resident, Dr.D Y Patil School Of Medicine and Hospital, Navi Mumbai

ABSTRACT **Introduction:** Direct Laryngoscopy and endotracheal intubation frequently induces a cardiovascular stress response characterized by hypertension, tachycardia, and dysrhythmias due to reflex sympathetic stimulation. The response is transient, occurring in 30 seconds after intubation and lasting for less than ten minutes This study was conducted to compare the efficacy of three drugs, intravenous esmolol, labetolol and lignocaine in low doses on hemodynamic response during laryngoscopy and endotracheal intubation with respect to haemodynamic parameters and peri-operative complications. **Methods:** Seventy five patients of either sex between age group of 18 to 60 years for were recruited and divided into 3 groups. Group ES (group receiving esmolol 0.5mg/kg) and group LB (group receiving labetalol 0.25mg/kg) and group LG (group receiving lignocaine 1mg/kg). We observed the haemodynamic parameters such as heart rate , systolic blood pressure , diastolic blood pressure , mean arterial pressure, Spo2 at baseline , immediately after the study drug, immediately after intubation, at 1(one min), 3(three min), 5(five min), 7(seven min) and 10 (ten min) after intubation. **Results:** There was no statistically significant difference (p-value > 0.05) among the three study groups in terms of distribution of demographic data like age, gender, weight and ASA grading. Labetalol was accompanied by minimal attenuation of hemodynamic response (SBP, DBP, HR, MAP) as compared to esmolol and lignocaine. Labetalol showed more decrease in HR, SBP and MAP in comparison to esmolol and lignocaine. Labetalol and esmolol showed decrease in DBP in comparison to lignocaine. Tachycardia was seen due to various hemodynamic responses to laryngoscopy and intubation. Tachycardia was seen more evidently in lignocaine group. **Conclusion:** Laryngoscopy and endotracheal intubation are invariably associated with increase in hemodynamic variables. Labetalol is an effective and safe drug to be used for attenuation of sympathomimetic responses to endotracheal intubation. Esmolol and lignocaine are also effective to some extent and are safe. However; further studies are recommended, for better exploration of results.

KEYWORDS : Laryngoscopy, Labetalol, Esmolol, Lignocaine, Tachycardia, Dysrhythmias

INTRODUCTION

Endotracheal intubation plays a major part for maintaining airway in patients and also helps in maintaining the ventilation and oxygenation. Intubation is a technique done all over the world in emergency rooms and in operating rooms.[1]

In emergency cases, the main goal of endotracheal intubation is to maintain the airway. The signs for need of endotracheal intubation include poor respiratory drive, poor patency of the airway, hypoxia, and hypercarbia. The patient's mental status, level of consciousness, rate of respiration, and level of oxygenation evaluates the signs. In cases with trauma, a Glasgow Coma Scale of 8 or less is a sign for intubation. [2-4]

Various hemodynamic responses are caused by laryngoscopy and intubation. This technique performed under general anaesthesia can result in tachycardia and hypertension. Laryngoscopy and intubation may lead to complications such as acute left ventricular failure, arrhythmias, intracranial haemorrhage and pulmonary oedema due to impact on the cardiovascular system. Convulsions may be present. Several types of dysrhythmias can be seen in addition to sinus tachycardia and bradycardia.[5]

As laryngoscopy and tracheal intubation produces marked sympathetic response, the subjects with coronary artery disease, hypertension and cerebrovascular pathologies may lead to myocardial ischemia, arrhythmias, infarction and even cerebral haemorrhage. Further, this increases sympatho-adrenal activity and results in hypertension and arrhythmias. Momentary hypertension and tachycardia are a matter of concern in these subjects. Laryngoscopy and intubation in such individuals leads to pulmonary oedema, myocardial infarction and cerebrovascular incidents. Therefore, it is needful to blunt these harmful reactions to laryngoscopy.[6,7]

Various pharmacological approaches have been manifested to lower the extent of hemodynamic response to laryngoscopy. The ideal medication should have qualities such as effectiveness, analgesic, antisialagogue, antiemetic properties and should not cause cardiovascular or respiratory depression.[6,7]

Esmolol has properties such as an ultra short-acting intravenous cardioselective beta antagonist. When esmolol is administered as a bolus and is continuously infused, onset of activity occurs within two minutes. The almost complete steady-state beta blockade occurs within a time period of five minutes. It leads to full recovery within 20 to 30 minutes after termination of the infusion. Esmolol blood concentrations are undetectable post infusion.[8]

Labetalol can be used orally and intravenously for treatment of hypertension as a combined alpha- and beta-adrenoceptor blocking agent. It is a nonselective antagonist as well as

competitive antagonist at beta-adrenoceptors and postsynaptic alpha 1-adrenoceptors respectively.

Lignocaine is widely used as a local anaesthetic and antiarrhythmic drug. It is commonly given in subjects with acute myocardial infarction for ventricular fibrillation. The mechanism of action of lignocaine can occur in two ways either as local anesthetizing action of the mucosa or drugs systemic absorption. Lignocaine may be rapidly absorbed into the circulation after an IV injection.[9]

Hence, the present study was conducted for analysing and comparing low doses of intravenous esmolol, labetalol and lignocaine for attenuation of haemodynamic response to laryngoscopy and endotracheal intubation.

Methods

Ethics approval for this study was provided by The Institutional Ethics Committee for Biomedical and Health research, from our institute. Research study was conducted from October 2020 to May 2022. A total of 75 study participants were allocated into three groups of 25 each :

- Group receiving Esmolol (Group ES) : Injection esmolol HCl 0.5 mg/kg diluted to 10 ml with 0.9% saline given IV over 60 seconds 5 min before intubation
- Group receiving Labetalol (Group LB): Injection labetalol HCl 0.25 mg/kg diluted to 10 ml with 0.9% saline given IV over 60 seconds 5 min before intubation
- Group receiving Lignocaine (Group LG): Injection lignocaine HCl 1 mg/kg diluted to 10 ml with 0.9% saline given IV over 60 seconds 5 min before intubation

Patients of age between 18-60 years of both sexes undergoing elective surgery under general anesthesia with MPC I and II were included in the study. Pregnant and lactating mothers along with patients with comorbidities such as uncontrolled hypertension, diabetes and ischemic heart diseases , history of bronchial asthma and peripheral vascular diseases and patients with hepatic and renal impairment or on antiplatelets were excluded from the study.

The primary objective was to compare the effects of Intravenous Esmolol, Labetalol and Lignocaine in low doses on hemodynamic response during laryngoscopy and endotracheal intubation. Secondarily, any adverse effects and overall clinical outcomes were also assessed.

After obtaining approval and clearance from the institutional ethics committee, the patients fulfilling the inclusion criteria were enrolled for the study after obtaining informed consent.

A day prior to surgery patients were interviewed and examined. Proper preoperative evaluation and relevant investigations as per record form was done. All patients were kept nil per oral for 6 hours prior to surgery . On arrival of patient in the operation theatre, monitors were attached and the baseline vitals were recorded. General anaesthesia was administered after adequate pre-oxygenation and premedication. At the time of intubation and laryngoscopy any adverse effects like bradycardia, tachycardia, hypotension, hypertension, arrhythmia or desaturation was noted. Maintenance of anaesthesia was with oxygen, air and sevoflurane/isoflurane with controlled ventilation using closed circuit. At the end of surgery patient was extubated and shifted to recovery for monitoring of vitals. Readings of hemodynamic parameters (HR, SBP, DBP, MAP , SPO2) were taken as baseline value (BV), Immediately after administration of the study drug, Immediately after intubation, at 1(one min after intubation), 3(three min after intubation), 5(five min after intubation), 7(seven min after intubation) and 10 (ten min after intubation).

All the collected data was entered in Microsoft Excel sheet and then transferred to SPSS software ver. 22 for analysis. Demographic data was analysed with Chi-square test and independent t-test. For comparison of means between groups ANOVA statistical tool was used. P-value < 0.05 was taken as level of significance. The observations were compiled in tabulated manner and results were statistically analysed using Stat graphic centurion, version 22 software (SPSS). A p value of < 0.05 was considered to indicate statistical significance and p value of < 0.001 was considered to be statistically highly significant.

RESULTS

The study enrolled a total of 75 patients equally divided into three groups: Esmolol (Group ES), Labetalol (Group LB), and Lignocaine (Group LG), with 25 patients in each. All groups were comparable in terms of baseline demographic variables, including age, gender distribution, weight, and ASA physical status, with no statistically significant differences observed ($p > 0.05$), ensuring that patient characteristics did not confound the hemodynamic outcomes. Their demographic parameters are summarized in Table 1.

Table 1 Demographic Parameters of Study Population

Demographic Variables	Group ES	Group LB	Group LG
Age	41.56 ± 11.25	40.92 ± 10.52	41.80 ± 9.03
Gender	Male – 60% Female – 40%	Male – 64% Female – 36%	Male – 64% Female – 36%
Weight	66.81 ± 6.73	69.94 ± 7.61	66.95 ± 12.32

Heart Rate

At baseline, the heart rate was similar among the three groups ($p = 0.832$). Following administration of the study drugs, significant differences emerged ($p = 0.012$), with Group LB showing the most stable heart rate, while Group LG demonstrated the highest increase. After intubation, Group LB maintained the most attenuated response (mean HR ~98.52 bpm), whereas Group LG showed the highest heart rate (~111.32 bpm), and Group ES exhibited intermediate control (~109.68 bpm). This pattern persisted across subsequent time intervals (1, 3, 5, and 7 minutes), with Group LB maintaining significantly lower heart rates compared to Groups ES and LG (all $p < 0.005$). By the 10-minute mark, heart rates in all groups approached baseline values, but Group LB continued to show the most stable trend ($p = 0.014$).

Table 2 P-values of Observed Parameters

Time Point	HR	SBP	DBP	MAP	SpO_2
Baseline	0.832	0.768	0.852	0.684	0.798
Post-drug	0.012*	0.005*	0.008*	0.003*	0.942
Post-intubation	0.001*	0.004*	0.001*	0.002*	0.826
1 min	0.001*	0.003*	0.002*	0.004*	0.861
3 min	0.001*	0.002*	0.001*	0.001*	0.852
5 min	0.002*	0.002*	0.002*	0.001*	0.873
7 min	0.003*	0.004*	0.002*	0.003*	0.916
10 min	0.014*	0.006*	0.004*	0.005*	0.883

Systolic Blood Pressure

Baseline systolic blood pressures (SBP) were similar across the groups ($p = 0.768$). Post-drug administration, significant intergroup differences were seen ($p = 0.005$). After intubation, the SBP peaked in Group LG (~137.68 mmHg), indicating poor control of the sympathetic response. In contrast, Group LB showed the least rise (~122.4 mmHg), suggesting effective suppression, while Group ES showed moderate attenuation (~132.8 mmHg). These differences remained statistically significant at all subsequent time points (1, 3, 5, and 7 minutes), with Group LB consistently demonstrating superior SBP control (all $p < 0.004$). By 10 minutes, SBP values normalized across all groups, but Group LB remained significantly lower compared to the others ($p = 0.006$).

Diastolic Blood Pressure

Diastolic blood pressures (DBP) were statistically similar at baseline ($p = 0.852$). Post-drug administration and especially post-intubation, the differences became significant ($p = 0.008$ and 0.001 respectively). Group LB showed the most stable diastolic pressures throughout, while Group LG demonstrated the highest readings, peaking at 95.6 mmHg at 1 minute post-intubation. Group ES again showed intermediate control. These differences remained significant at 3, 5, and 7 minutes ($p < 0.002$), highlighting the superior efficacy of labetalol in blunting diastolic responses to laryngoscopy.

Mean Arterial Pressure (MAP)

Mean arterial pressure (MAP) followed a similar pattern to SBP and DBP. While baseline MAPs were statistically comparable ($p = 0.684$), post-drug and post-intubation values revealed significant differences ($p = 0.003$ and 0.002, respectively). Group LB exhibited the most controlled MAP response, maintaining values near baseline throughout the observation period. Group LG showed the highest MAP elevation, peaking at 108.08 mmHg at 1 minute. Significant differences persisted at 3, 5, and 7 minutes (all $p < 0.005$), again favoring labetalol for optimal hemodynamic stability. By 10 minutes, MAP values approached baseline, but intergroup differences remained significant ($p = 0.005$).

Oxygen Saturation (SpO_2)

There were no statistically significant differences in SpO_2 at any point during the study (all $p > 0.79$). Baseline saturation levels were comparable (~98.3–98.5%), and all groups maintained stable oxygenation throughout, with minimal fluctuations. This indicates that none of the study drugs, in the doses administered, adversely affected oxygen saturation or respiratory function.

Adverse Effects

In terms of adverse effects, tachycardia was more frequently observed in the lignocaine group (12%), followed by the esmolol group (8%). The labetalol group had the least incidence (4%). No episodes of bradycardia, hypotension, or oxygen desaturation were recorded in any group, confirming the safety of all three agents at the given doses

DISCUSSION

Labetalol group demonstrated the most consistent and effective control of heart rate. Unlike esmolol and lignocaine, which showed peaks immediately post-drug and post-intubation (HR ~109–112 bpm), labetalol showed a dampened response, with near-baseline values (peak ~101 bpm), suggesting superior beta-blockade effect. The rise in HR was minimal in the LB group and returned to baseline faster than in ES and LG groups. Singh SP et al.[10] demonstrated that labetalol 0.25 mg/kg led to superior HR control compared to esmolol during intubation. Bostan H et al.[11] concluded esmolol was better than lignocaine in HR control, but labetalol was more potent than both in our study.

BP spiked the highest in the lignocaine group, reaching 137.68 mmHg post-intubation, indicating inadequate suppression of sympathetic response. In contrast, labetalol reduced SBP below baseline levels post-intubation and maintained lower SBP throughout the observation period, confirming dual alpha-beta blocking efficacy. Sharma S et al.[12] and Feng CK et al.[13] confirmed esmolol's efficacy in controlling SBP rise, although higher doses were used whereas Singh SP et al.[10] found labetalol to be more effective than esmolol in controlling SBP at intubation.

Similar to SBP, DBP was most stable in the LB group. The lignocaine group again showed exaggerated pressor responses (~95–97 mmHg DBP). Esmolol had intermediate control. Ugur B et al.[14] noted esmolol reduced DBP more effectively than lignocaine whereas Gupta A et al.[15] observed minimal DBP suppression with lignocaine, supporting our findings. Singh SP et al.[10] reported labetalol's superior DBP control in low doses compared to esmolol.

MAP readings followed trends seen with SBP and DBP. The LG group showed highest MAP spikes (peak ~108 mmHg), while the LB group had the lowest and most stable MAP (lowest ~93 mmHg), reinforcing its balanced cardiovascular control. Figueredo E et al.[16] meta-analysis showed esmolol reduced MAP in a dose-dependent manner, supporting the need for higher doses than used here. Singh SP et al.[10] and Paudel B et al.[17] concluded labetalol has superior MAP stability.

SpO_2 remained stable and comparable in all three groups with no significant changes throughout the study period, reflecting the safety of all three agents. Most published literature did not report significant desaturation with any of these drugs, aligning with our results. Our data confirm that low-dose labetalol, esmolol, and lignocaine do not compromise respiratory function or oxygenation.

This study confirms that all three drugs attenuate the hemodynamic response to intubation, but labetalol demonstrated the most consistent and pronounced effect across all major cardiovascular parameters.The dual alpha- and beta-blockade offered by labetalol likely explains its superiority. Esmolol, although effective in reducing HR, was less consistent for blood pressure. Lignocaine, despite its membrane-stabilizing properties, was least effective and showed higher rates of tachycardia.No significant adverse effects were observed in any group, confirming the safety of all three drugs at the studied dosages.

CONCLUSION

Labetalol at 0.25 mg/kg is more effective than esmolol (0.5 mg/kg) and lignocaine (1 mg/kg) in attenuating the hemodynamic stress response to laryngoscopy and intubation. It is a viable option for preventing peri-intubation cardiovascular surges, particularly in vulnerable patients. Further studies with larger samples and high-risk populations are required.

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