Comparative effects of esmolol and airway blocks in attenuating the hemodynamic response to laryngoscopy and intubation

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Abstract

Background and Aims: Hemodynamic stability is one of the main goals of any anaesthesiologist. The main cause of transient hemodynamic instability and interruption of patients airway reflexes is laryngoscopy and intubation. This study was done to compare the effects of esmolol and airway blocks in attenuating the hemodynamic response to laryngoscopy and intubation.

Methods: After approval of the study protocol by the institutional ethical committee, written informed consent was obtained from each patient. It was a randomized controlled double blinded study. 60 patients of American Society of Anesthesiologists physical status one and two scheduled for elective surgery under General Anaesthesia, aged between 18 and 65 yrs were randomly allocated into two groups - esmolol (n=30) and airway blocks (n=30). Group 1 received injection esmolol 0.5mg/kg body weight. Group 2 received superior laryngeal nerve both sides with 2ml 2% plain Lignocaine each side and translaryngeal block with 3 ml 4% Lignocaine.

Results: Following laryngoscopy and intubation, the increase in systolic blood pressure, diastolic blood pressure and heart rate were significantly lower (p<0.05) in airway blocks group after 1 min and after 5 mins of intubation.

Conclusion: Airway blocks was significantly more effective in attenuating the hemodynamic response to laryngoscopy and intubation in comparison to esmolol 0.5mg/kg.

Keywords: Hemodynamic response, airway blocks, esmolol, laryngoscopy, intubation

Introduction

Hemodynamic stability is one of the main goals of any anaesthesiologist. The main cause of transient hemodynamic instability and interruption of patients airway reflexes is laryngoscopy and intubation [1]. It has detrimental effects on the other organs especially in patients with COPD, heart diseases and high blood pressure and associated with morbidity at times [2, 3]. They are associated with hemodynamic changes due to sympathetic response leading to increase in plasma concentration of adrenaline and noradrenaline.

Hemodynamic response to laryngoscopy and intubation was first described by Reid and Brace in 1940. There are several methods in modifying the hemodynamic response, Eg. deep anesthesia and use of ganglion blockers [5]. Similarly, several cardiovascular drugs such as esmolol, lidocaine, nitroprusside, gabapentin, pregabalin, dexmedetomidine, verapamil and clonidine have been tested to blunt the acute hemodynamic response to tracheal intubation [6-11].

Various studies have shown that esmolol is more effective in attenuating the sympathetic response to laryngoscopy and intubation [12]. Beta-adrenergic receptor blocking drugs, eg. esmolol, is found to be more effective in controlling the increase in heart rate than the rise in blood pressure [13].

One of the indications for awake airway management is severe hemodynamic instability [14]. Lidocaine is the most commonly used local anesthetic because of its rapid onset, high therapeutic index and availability in a wide range of preparations and concentrations [15, 16].

The superior laryngeal nerve, a branch of vagus nerve provides sensory input from the lower pharynx and upper part of larynx, including the glottis surface of the epiglottis and the aryepiglottic folds. Translaryngeal/Transtracheal block provides anaesthesia of the trachea and vocal cords. It makes the presence of the ETT in the trachea more comfortable. The maximum dose of lidocaine for application to the airway is not well established; different
Monitoring for signs and symptoms of lidocaine toxicity, including tinnitus, perioral tingling, metallic taste, light headedness, dizziness and sedation is important. Severe lidocaine overdose can cause hypertension, tachycardia, seizures and cardiovascular collapse [19].

**Materials and methods**

This study was done in Mamata Medical College and Hospital, Khammam from November 2020 to April 2021 on forty ASA I and ASA 2 patients selected for elective surgeries under General Anaesthesia and endotracheal intubation. This study was approved by institutional ethical committee and written informed consent from patients.

Patients included in the study were ASA I and ASA 2, both genders, aged between 18 and 65 years, who underwent General anaesthesia with endotracheal intubation and agreed to participate in study. The exclusion criteria were: Patients with difficult predicted airway, Body mass index (BMI)>35 kg/m², Previous use of beta blockers or calcium channel blockers, cardiac arrhythmias, renal dysfunction, airway hyperreactivity, hypersensitivity to drugs used, pregnancy, COPD.

All patients are administered oral alprazolam 0.25 mg on the night before surgery. Using block randomisation, 60 patients satisfying the inclusion criteria were randomly assigned to each group of 30 patients each. Group 1 received injection esmolol 0.5mg/kg body weight. Group 2 received superior laryngeal nerve block with 3 ml 4% plain lignocaine and recurrent laryngeal nerve block with 3 ml 4% Lignocaine.

In the operation theatre, patients were made to lie supine and intravenous infusion line was secured and standard monitoring devices measuring Non invasive blood pressure (NIBP), Pulse rate (PR), percentage oxygen saturation (SpO2) and continuous echocardiography (ECG) were attached and baseline values were recorded. All patients were premedicated with 0.2 mg iv injection glycopyrrolate 0.01 mg/kg iv, injection Fentanyl 1 mcg/kg iv, injection Midazolam 0.5mg/kg iv. The laryngoscopes and intubation time were noted. At the end of study period position of patient residual neuromuscular paralysis was antagonised with injection neostigmine 0.05 mg/kg body weight and glycopyrrolate 0.01 mg/kg iv. Oropharyngeal suctioning was done and when adequate spontaneous ventilation was established patients were extubated. Subsequently patients were shifted to respective wards.

**Results**

It is a randomised controlled double blinded study. Students t test was used here to obtain the p value.

In this study, there was no significant difference in demographic and clinical variables among the study groups. The results were shown in table 1.

| Variables | Airway blocks (n=30) | Esmolol (n=30) | P value |
|-----------|---------------------|----------------|---------|
| Age (Years) Mean, SD | 36±8.76 | 33.16±7.53 | 0.24 |
| Gender (M/F) | 12/18 | 14/16 | 0.56 |
| Weight (Kgs) | 65.12±8.12 | 68.65±7.87 | 0.34 |
| Height (Cms) | 165.45±15.25 | 167.21±18.21 | 0.65 |
| ASA (I/II) | 15/5 | 16/14 | - |
| Mallampati Grading | 18/12 | 16/14 | - |

**Heart rate**

The baseline heart rate was not significantly changed among the study groups. However, in airway block group the heart rate was significantly lower after 1(p=0.004) and 5 mins (p=0.006) laryngoscopy as compared to the Esmolol group. The results were shown in table 2.

| Heart Rate (mins) | Airway blocks (n=30) | Esmolol (n=30) | P value |
|-------------------|---------------------|----------------|---------|
| Baseline | 68.13±10.12 | 69.14±9.87 | 0.353 |
| 1min after laryngoscopy | 70.45±12.54 | 86.54±13.76 | 0.004 |
| 5mins after laryngoscopy | 72.26±12.34 | 81.65±14.13 | 0.006 |
Systolic blood pressure
The baseline systolic blood pressure was not significantly changed among the study groups. However, in airway block group the systolic blood pressure was significantly lower after 1 (p=0.001) and 5 mins (p=0.008) laryngoscopy as compared to the Esmolol group. The results were shown in table 3.

Table 3: Systolic blood pressure among the study groups

| Systolic blood pressure (mm/Hg) | Airway blocks (n=30) | Esmolol (n=30) | P value |
|--------------------------------|----------------------|---------------|---------|
| Baseline                        | 110.21±25.87         | 114.35±21.65  | 0.543   |
| 1min after laryngoscopy         | 120.65±28.12         | 132.45±31.23  | 0.001   |
| 5mins after laryngoscopy        | 114.75±22.76         | 128.32±20.6   | 0.008   |

Diastolic blood pressure
The baseline diastolic blood pressure was not significantly changed among the study groups. However, in airway block group the diastolic blood pressure was significantly lower after 1 (p=0.004) and 5 mins (p=0.013) laryngoscopy as compared to the Esmolol group. The results were shown in table 4.

Table 4: Diastolic blood pressure among the study groups

| Diastolic blood pressure (mm/Hg) | Airway blocks (n=30) | Esmolol (n=30) | P value |
|--------------------------------|----------------------|---------------|---------|
| Baseline                        | 72.16±9.87           | 74.65±8.12    | 0.765   |
| 1min after laryngoscopy         | 74.24±8.14           | 85.12±8.12    | 0.004   |
| 5mins after laryngoscopy        | 70.56±7.76           | 78.45±9.12    | 0.013   |

Oxygen Saturation
In this study, there was no significant difference in the oxygen saturation among the study groups. The results were shown in table 5.

Table 5: Oxygen Saturation levels among the study groups

| Saturated Oxygen (%) | Airway blocks (n=30) | Esmolol (n=30) | P value |
|----------------------|----------------------|---------------|---------|
| Baseline             | 98.44±8.65           | 97.76±9.12    | 0.123   |
| 1min after laryngoscopy | 99.25±10.14       | 98.65±11.24   | 0.242   |
| 5mins after laryngoscopy | 99.45±11.56       | 99.12±9.87    | 0.187   |

Discussion
Insertion and withdrawal of a laryngoscope and endotracheal tube during intubation can irritate the sympathetic nervous system, leading to severe tachycardia.
hypertension or arrhythmia [20]. Insertion of a laryngoscope and/or endotracheal tube into the upper airways may directly produce pressure stimulation on laryngeal tissue which causes marked cardiovascular responses by irritating the deep sensory receptors of the larynx. 

Anaesthesia applied to the larynx or trachea is effective in suppressing intubation induced increases in blood pressure as well as blocking cardiovascular responses to airway irritation. Superior laryngeal nerve block which anesthetize larynx above the vocal cords level and abolishes glottic closure reflex and transtracheal nerve block which anesthetize larynx below the vocal cords, the trachea and abolish cough reflex were used in this study. Airway nerve blocks provide deep and rapid anesthesia by small doses of local anesthetic, but this technique requires thorough knowledge of upper respiratory system anatomy, operator skill and experience; it also has risk of intravascular injection and sometimes neural injury can not be excluded. In cases of disturbed airway anatomy such as neck swelling, traumatic injury to the face or the neck and local infection, the airway block may become difficult.

The local anesthetic (lignocaine) concentrations used in our study were below the acceptable toxic limits and there were no signs and symptoms of lignocaine toxicity. We found that lignocaine when used for superior laryngeal nerve block and transtracheal block before intubation, can inhibit hemodynamic responses during intubation. Esmolol is an ultrashort acting, beta-1 cardioselective adrenergic receptor blocker with a distribution half life of 2 min and an elimination half life of 9 min. Esmolol appears quite suitable for use during a short lived stress such as tracheal intubation. Esmolol is effective in a dose dependent manner in the attenuation of the sympathomimetic response to laryngoscopy and intubation. Bensky et al. (21) It is suitable for use during a short lived stress such as tracheal intubation. It causes depressor effect on myocardium. Esmolol has the potential to reduce the requirement of opioids, such as fentanyl, in addition to reducing the incidence of nausea and vomiting in the postoperative period. Bolus administration was chosen due to the practicality and rapid onset of the drug, directed to the transient cardiovascular response under study. Singhal et al. concluded that a bolus of 1.5 mg/kg esmolol three minutes before intubation is safe and effective to attenuate hemodynamic changes.

Our study demonstrated that the use of airway blocks was more effective in decreasing the hemodynamic response to laryngoscopy and intubation. In airway block group, the heart rate was significantly lower after 1 (p=0.004) and 5 mins (p=0.006) laryngoscopy as compared to the esmolol group. In airway block group, the systolic blood pressure was significantly lower after 1 (p=0.001) and 5 mins (p=0.008) laryngoscopy as compared to the esmolol group. In airway block group, the diastolic blood pressure was significantly lower after 1 (p=0.004) and 5 mins (p=0.013) laryngoscopy as compared to the esmolol group.

Esmolol group did not reveal any rhythm abnormality. No ST segment changes were seen in any patients. Sabahet et al. used esmolol 1 mg/kg and concluded that esmolol partially attenuated the hemodynamic response but did not abolish it completely.

Conclusion
In this study, based on the results obtained by Students t test, Airway blocks(superior laryngeal nerve block-2 ml of 2% lignocaine each side and transtlaryngeal block - 3 ml of 4% lignocaine intratracheal) were found to be superior to esmolol 0.5mg/kg IV in controlling the hemodynamic response to laryngoscopy and intubation.

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