Attenuation of Hemodynamic Response to Tracheal Extubation: Comparison of Esmolol and Lidocaine

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ABSTRACT

INTRODUCTION: Tracheal extubation causes 10% to 30% transient increase in blood pressure and heart rate. This hemodynamic instability can cause various deleterious effects like myocardial infarction, cerebrovascular hemorrhage etc. So we did a study to compare the efficacy of esmolol and lidocaine in blunting the hemodynamic response during extubation.

METHODS: Sixty patients aged between 20 to 60 years, ASA I and II scheduled for elective surgery requiring general anesthesia were enrolled in this randomized, double blind study. At the end of surgery Isoflurane was discontinued and patients were reversed. Two minutes later Group I received a bolus dose of esmolol 1.5 mg/kg and Group II received lidocaine 1 mg/kg. After 1 minute of study drug administration oropharyngeal suctioning was done and after 3 min the tracheal tube was extubated. Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP) and heart rate (HR) were recorded at different time intervals before and after extubation. Intra and intergroup comparison were done to determine the effectiveness of the study drugs.

RESULT: There was no significant increase in HR, SBP, DBP and MAP in Group I at the time of extubation when compared with the values at the end of surgery as their p values were > 0.05. In Group II there was significant increase in SBP at the time of extubation as compared to the value at the end of surgery (p=0.000) When comparing between the two groups, there was a significant increase in HR at the time of oropharyngeal suctioning and 1 min after extubation where as a significant increase in SBP at the time of oropharyngeal suctioning, at the time of extubation and 3 min after extubation in Group II as compared to Group I (p<0.05).

CONCLUSION: Esmolol (1.5 mg/kg) given 3 min before tracheal extubation is better than lidocaine (1 mg/kg) in attenuating the hemodynamic response to extubation.

KEY WORDS: Esmolol, Hemodynamic response, Lidocaine, Tracheal Extubation.

INTRODUCTION

Tracheal extubation is one of the most frequently performed procedures in the practice of anesthesiology. Many investigators have documented that tracheal extubation causes 10% to 30% transient increase in blood pressure and heart rate lasting for 5 to 15 minutes.[1] But tracheal extubation has always received less emphasis than intubation. Laryngoscopy, endotracheal intubation as well as endotracheal extubation are almost always associated with hemodynamic changes due to reflex sympathetic discharge caused by epipharyngeal and laryngopharyngeal stimulation. This is explained by the increase in plasma levels of norepinephrine and, to a lesser extent, epinephrine, which occur during airway instrumentation.[2] In healthy patients these responses are generally well tolerated. But in some patients, particularly those suffering from myocardial or cerebral vascular disease, these responses may

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be harmful though it is transient and may cause pulmonary edema, cardiac failure and cerebrovascular hemorrhage.[3]

Several pharmacological methods have been studied to blunt the hemodynamic response to extubation such as lidocaine[4], fentanyl[5], propofol[6], labetalol[7], esmolol[8], verapamil[9]. But none of these above methods have evolved as the standard method for attenuating the hemodynamic response to extubation. Propofol can be used to attenuate hemodynamic response but it impairs upper airway protection and increases risk of pulmonary aspiration. Opioids delay the return of spontaneous ventilation. The incidence of bradycardia is seen more with labetalol. Lidocaine can cause more sedation due to central nervous system depressant effect. In our institution we are mostly using extubation at deeper plane of anesthesia or intravenous lidocaine to blunt hemodynamic responses to extubation. This study was done to compare the efficacy of esmolol and lidocaine in blunting the hemodynamic response to extubation as esmolol is a cardioselective drug with short duration of action (nine minutes) and is easily available.

METHODS

This was a prospective, randomized and double blind study. After approval from the Institutional Review Board of National Academy of Medical Sciences, sixty patients were enrolled in the study. The patients enrolled were of aged between 20 to 60 years, American Society of Anesthesiologist Physical Status (ASA) I and II and scheduled for elective surgery requiring general anesthesia with endotracheal intubation. Patients with sinus bradycardia, history of bronchospasm, hypertension, arrhythmias and ischemic heart disease were excluded from the study. Patients were divided into 2 groups, 30 in each group. Randomization was done by lottery method. Informed written consent was obtained from patients enrolled in the study. All patients were premedicated with Inj. midazolam 0.04 mg/kg. Inj. pethidine 0.5 mg/kg was given for analgesia. Patients were induced with propofol in titrating dose sufficient to obtund eyelash reflex then were ventilated with tight fitted mask with oxygen. Once the possibility of ventilation was confirmed, muscle relaxant vecuronium 0.12mg/kg was given then ventilated with oxygen and isoflurane 1% for 3 min. Then orotracheal intubation was done with the endotracheal tube of appropriate size. Anesthesia was maintained with isoflurane, oxygen and vecuronium. At the end of surgery, when the patients were recovered from the effect of muscle relaxants isoflurane was discontinued. The patients were reversed with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg after assessing the presence of adequate volume of spontaneous respiration. Two minutes later patients in Group I received a bolus dose of esmolol 1.5 mg/kg and Group II received lidocaine 1 mg/kg. A minute after the administration of the study drug; oropharyngeal suctioning was done and two minutes later tracheal tube was extubated.

Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR) and arterial oxygen saturation (SPO2) were monitored and recorded at the end of surgery, at the time of giving reversal, 1 min after giving reversal, at the time of study drug administration (2 min after giving reversal), at the time of oropharyngeal suctioning (1 min after study drug administration), at the time of extubation (3 min after study drug administration) and 1 min, 3 min, 5 min and 10 min after extubation.

Data was analyzed by using Software Package for Social Sciences (SPSS) 16. Numerical variables such as age, weight, HR, SBP, DBP, and MAP were compared between the two groups by independent t-test. Categorical variables were compared by using chi square test. Paired t test was used for comparison of HR, SBP, DBP and MAP within a group at different time intervals. P value less than 0.05 was taken statistically significant. Results were presented as mean ± SD.

RESULTS

There were no significant differences among two groups regarding the demographic data of the patients and preoperative HR, SBP, DBP and MAP as shown in Table1.

Table 1: Demographic data of the patients and preoperative hemodynamic values.			
Variables	Group I (n=30)	Group II (n=30)	Test of significance (P<0.05)
Age in years (mean ± SD)	30.10 ± 8.31	34.73 ± 10.28	0.06
Gender (male/female)	10 / 20	8 / 22	0.573
Weight in kg (mean ± SD)	50.23 ± 10.7	56.93 ± 11.07	0.595
ASA I/II	30/0	29/1	0.313
Preoperative Heart Rate	83.80 ± 9.26	81.70 ± 10.11	0.405
Preoperative Systolic BP	115.70 ± 23.41	122.1 ± 13.05	0.194
Preoperative Diastolic BP	77.83 ± 9.38	73.60 ± 7.514	0.059
Preoperative Mean Arterial pressure	91.00 ± 11.18	89.90 ± 9.11	0.687

Heart rate at the end of surgery was also comparable between the two groups. There was significant increase in heart rate at the time of oropharyngeal suctioning and 1 min after extubation in Group II when compared to Group I (p<0.005) as shown in Fig 1.

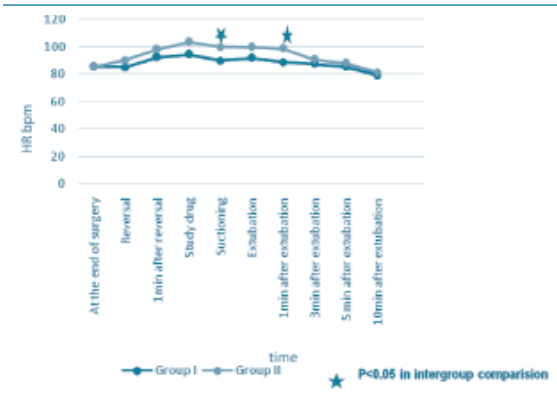

Figure 1: Heart rate in two groups at different time intervals

When comparing the heart rate at the end of surgery with the values at the time of extubation within the groups, there was significantly increased in heart rate in Group II (p=0.000), while the values were not significant in Group I, as shown in Table 2.

Table 2: Comparison of heart rate at the end of surgery with the value at the time of tracheal extubation within the groups (mean ± SD).		
	Group I	Group II
HR at the end of surgery (bpm)	84.34 ± 13.70	85.23 ± 16.32
HR at the time of extubation (3min after giving study drug)	91.52 ± 14.03	99.57 ± 20.87
P value	0.061	0.0001*

The systolic blood pressure was significantly increased at the time of oropharyngeal suctioning, at the time of extubation and 3 min after extubation in Group II as compared to Group I as shown in Fig 2.

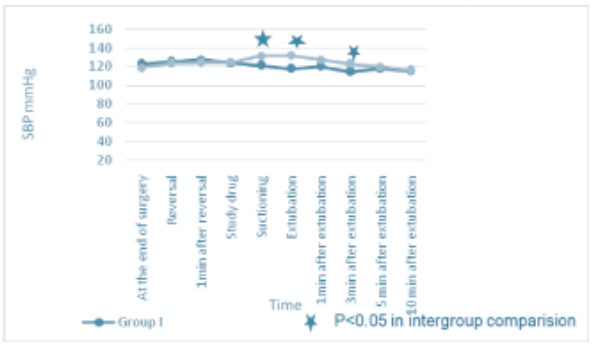

Figure 2: Systolic blood pressure in two groups at different time intervals

There was significant increase in systolic blood pressure at the time of extubation when compared with the values at the end of surgery in Group II (p = 0.0001), where as the values were not significant in Group I as shown in Table 3

Table 3: Comparison of Systolic blood pressure at the end of surgery in mmHg and the value at the time of tracheal extubation within the groups (mean ± SD).		
	Group I	Group II
SBP at the end of surgery(mmHG)	122.63 ± 12.17	119.1 ± 11.33
SBP at the time of extubation (3 min after giving study drug)	117.62 ± 14.35	132.03 ± 16.87
P value	0.166	0.0001*

Significant difference in diastolic and mean arterial pressure was not found between the two groups at different times, or within the two groups when the values were compared with DBP and MAP at the end of surgery. (Fig 3, 4)

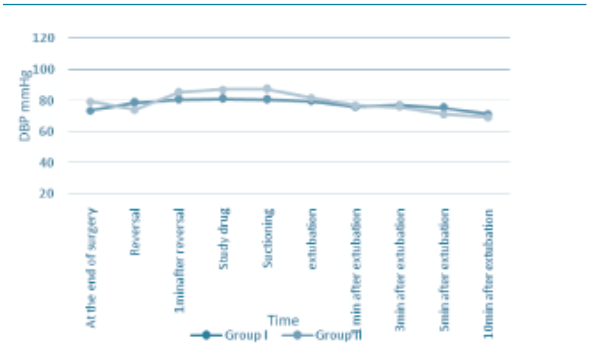

Figure 3: Diastolic blood pressure in two groups at different time intervals

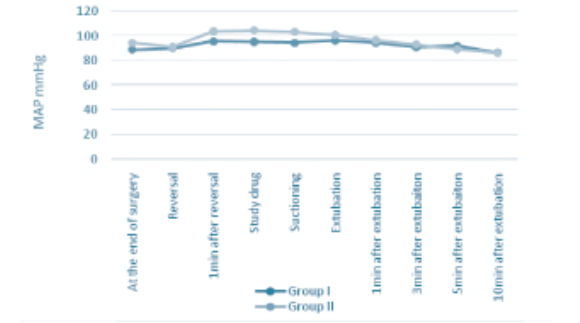

Figure 3: Mean Arterial Pressure in two groups at different time intervals

DISCUSSION

Tracheal extubation is hemodynamically as important and stressful to patient as intubation and should be smooth for the benefit of the patient. Tracheal extubation, which is usually done in light plane of anesthesia, produces increase in heart rate and arterial blood pressure. Other unwanted effects of extubation are laryngospasm, bucking, coughing and increase in intracranial pressure. The hemodynamic effects of tracheal extubation usually persist for up to 10 minutes postoperatively4.

The hemodynamic responses and coughing during tracheal extubation can be attenuated by various methods such as extubation with the patient in a deep plane of anesthesia achieved by inhalational anesthetic agents or by using drugs like fentanyl5, labetalol7, propofol6 etc at the time of extubation. But this may lead to various adverse effects like respiratory depression, delayed recovery, cardiovascular system instability or difficulty in maintaining the upper airway.

In our study we compared the efficacy of esmolol (1.5 mg/kg) and lidocaine (1 mg/kg) given 3 minutes prior to extubation to blunt the hemodynamic responses to extubation. This study demonstrated that esmolol was able to attenuate the increase in systolic blood pressure and heart rate during extubation better than lidocaine.

Similar to our study O'Dwyer JP et al10 in 1993 also found that administration of esmolol 500 µg/kg as a loading dose given over 1 min just before giving reversal and followed by 100 µg/kg till 5 min after extubation attenuated heart rate and systolic blood pressure during reversal and extubation in patients undergoing coronary artery bypass grafting when compared with placebo. Although the method of administration and doses of esmolol was different in our study, we found that esmolol attenuates heart rate and systolic blood pressure at the time of extubation. Muzzi DA et at7 in 1990 also demonstrated that a loading dose of esmolol 500µg/kg followed by an infusion of 50-300 µg/kg/min and discontinued 10 min after extubation were able to attenuate HR, SBP, DBP and MAP during emergence and recovery from anesthesia after intracranial surgery.

Chhabra B et al 11 in 2003 found that esmolol and lidocaine given at a dose of 1.5 mg/kg and 1 mg/kg respectively, 2 min before extubation did not blunt the heart rate, systolic, diastolic and mean arterial blood pressure at the time of extubation and decreased to baseline value within 3 minutes after extubation. But in our study, we found that esmolol 1.5 mg/kg given 3 min prior to extubation attenuated the heart rate at the time of extubation. This difference could be due to the earlier administration of study drug and continuation of inhalational agent till the end of surgery in our study where as in their study inhalational agent was discontinued 5 minutes before the end of surgery. As the patients were in the lighter plane of anesthesia, extubation reflexes were not blunted.

Bidwai AR et al4 in 1979 observed that lidocaine 1 mg/kg given 2 minutes before extubation was able to decrease heart rate during extubation. But in our study heart rate in group II did not attenuate at the time of extubation. This difference could be due to the continuation of halothane till 1 minute before extubation in their study, while in our study we had discontinued halogenated agent at the end of surgery thereby extubating in light plane of anesthesia. However the diastolic and mean arterial blood

pressures were attenuated similarly to our study.

Sagedi M et al12 in 2008 on their study on comparison in effect of intravenous alfentanil 15µg/kg and lidocaine 1.5 mg/kg on airway circulatory reflexes during extubation observed that lidocaine 1.5 mg/kg, given 2 min before reversal of muscle relaxant could not attenuate HR during emergence. Even a higher dose of lidocaine was insufficient to attenuate HR. Simillarly in our study we had only used 1 mg/kg of lidocaine which is insufficient to blunt hemodynamic response to extubation.

In our study none of the patient suffered from laryngospasm, hypotension, bradycardia or sinoatrial or atrioventricular block requiring vaspressor or sympathomimetic drugs during tracheal extubation or in postoperative ward. We observed ventricular premature contraction in 3 patients before giving study drug. This could be due to light plane of anesthesia.

CONCLUSION

This study showed that esmolol 1.5 mg/kg, given 3 minutes before extubation attenuates heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure during extubation as compared to lidocaine 1 mg/kg. Lidocaine 1 mg/kg is insufficient to blunt hemodynamic responses to extubation. From the result of this study we recommended that esmolol 1.5 mg/kg can be used before extubation to attenuate hemodynamic response to extubation.

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