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COMPARATIVE EVALUATION OF ESMOLOL AND LIGNOCAINE ON ATTENUATION OF POST EXTUBATION HAEMODYNAMICS ON PATIENTS UNDERGOING ABDOMINAL HYSTERECTOMY

Anaesthesiology

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ABSTRACT

BACKGROUND: Tracheal extubation is carried out after surgery and it is associated with pain, anxiety and airway irritation which may lead to haemodynamic responses resulting in hypertension, tachycardia and arrhythmias. Different pharmacological agents such as lidocaine, β- blockers, fentanyl have been evaluated to blunt this stress response seen during extubation **METHODS:** This prospective randomized study was done in 60 patients to evaluate the effects of intravenous lignocaine vs esmolol given just before extubation in patients undergoing abdominal hysterectomy. **RESULTS:** SBP, DBP and MAP showed more decrease in esmolol group than lignocaine group. HR decreased in the esmolol group after giving the drug but in lignocaine group it increased after giving the drug and remained high throughout. Our results coincided with study done by different authors and we found that esmolol in dose 1.5 mg/kg was effective in attenuating the haemodynamic response to extubation. **CONCLUSION:** We conclude that esmolol effectively controls arterial pressure and heart rate when given as i.v. bolus in a dose of 1.5 mg/kg just before extubation whereas lignocaine is not as effective when given as an i.v. bolus as a dose of 1mg/kg just before extubation.

KEYWORDS

lignocaine, esmolol, extubation

INTRODUCTION

Tracheal extubation is an equally important part of general anaesthesia as intubation and is commonly carried out after surgery and anaesthesia when effects of muscle relaxant are fully reversed, and the patient is maintaining an acceptable respiratory rate and adequate tidal volume and hemodynamic parameters. Extubation is associated with awakening, pain, anxiety and airway irritation which may lead to haemodynamic responses such as hypertension, tachycardia and arrhythmias. The haemodynamic changes are due to reflex sympathetic discharge caused by epipharyngeal and laryngo pharyngeal stimulation.

Tracheal extubation is frequently associated with cardiovascular stress response because of increased serum concentration of catecholamines characterized by hypertension and tachycardia1. The increase in catecholamines leads to increased cardiac workload, heart rate and myocardial contractility which may lead to increased myocardial oxygen demand and could prove fatal particularly in patients suffering from coronary artery disease. Various factors are responsible for this haemodynamic response like pain of surgery, emergence from anaesthesia or tracheal irritation.[2,3]

Extubation of the trachea with patient in a deep plane of anaesthesia achieved by inhalational agents, opioids etc have been used to attenuate these hemodynamic responses to tracheal extubation but these ways can lead to respiratory and cardiovascular system depression and difficulty in maintaining the upper airway, further complicating the situation4 The present study was undertaken to evaluate the attenuating effects of lignocaine and esmolol which belong to different pharmacological groups on haemodynamic changes with tracheal extubation in patients undergoing abdominal hysterectomy.

METHODS

The study was done in 60 patients undergoing abdominal hysterectomy at S.M.S. Medical College and Group of Attached Hospitals (Mahila chikitsalya), Jaipur, after obtaining permission from the institutional Ethics committee and review board. The patients enrolled were of age 20 to 60 years, American society of anaesthesiologist grades I and II, scheduled for elective abdominal hysterectomy under general anaesthesia. Patients with difficult airway nad history of chronic diseases like hypertension, diabetes mellitus, respiratory disease, epilepsy and cardiac disease were excluded from the study. Patients were divided into two groups of 30 patients each. Randomization was done by sealed enveloped method. Informed written consent was taken from all the patients. In the operation theatre after placing the monitors baseline parameters were noted, (PR, SBP, DBP, MAP, Sp02, ECG) and an iv access was secured. Patient was given premedication with injection rantac 50 mg, injection raglan 2mg, injection midazolam 1mg and injection glycopyrrolate 0.2 mg. Patient was preoxygenated with 100% oxygen for 3 mintues.

Anesthesia was induced with injection thiopentone 5-7mg /kg iv and tracheal intubation was done after injection succinylcholine 1-1.5mg/kg iv. Anasthesia was maintained with 0.2-2% sevofluorane and 60% N20 in oxygen. Intra -operative monitoring included HR, SBP, DBP, MAP, SpO2 and ECG (lead II) was monitored. The BP was recorded immediately before the induction of anaesthesia and every five minutes during anaesthesia using automated noninvasive BP monitor. The ECG was monitored by ECG lead II. The BP and HR was maintained between 80% and 120% of the preoperative values by altering the concentration of sevofluorane before completion of surgery. Muscle relaxation was maintained by intermittent boluses of atracurium0.1 mg/kg i.v.

At the end of surgery sevofluorane was switched off and we waited for return of spontaneous respiration. Residual muscle relaxation was reversed with injection neostigmine 0.05-0.07 mg/kg iv and injection glycopyrrolate 0.005-0.01 mg/kg i.v. on appearance of spontaneous ventilation.1minute after the reversal was given the study medicines i.e, esmolol (1.5 mg/kg) or lignocaine(1mg/kg) was given i.v. These medicines were prepared before hand by an assistant and their identities were unknown to the anaesthetist, the total volume of study medicines was made to 10ml in both the groups. A thorough oropharyngeal suction was done before extubation. Then trachea was extubated 2 mins after the study medications once following criteria were met.

1. Return of spontaneous respiration with adequate tidal volume:
2. Patient is obeying verbal commands (eye opening)
3. Good hand grip
4. End tidal concentration of sevofluorane less than 0.1%

Immediately after tracheal extubation patient was given 100% oxygen by a facemask for 5 minutes

Monitoring was done at following intervals Baseline values at the completion of surgery –T0,At the appearance of spontaneous respiration-T1,At the time of giving reversal —T2,2 min after injecting study medication(before extubation) —T3,One minute after extubation-T4,Three minute after extubation-T5,Five minutes after extubation-T6.

Statistical analysis was performed with the SPSS, version 21 for Windows statistical software package (SPSS inc., Chicago, IL, USA). The Categorical data was presented as numbers (percent) and were compared among groups using Chi square test. The quantitative data was presented as mean and standard deviation and were compared by students t-test. Probability was considered to be significant if less than 0.05.

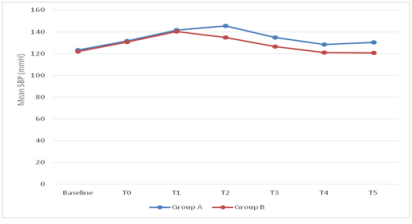
RESULTS

There were no significant differences between the two groups regarding the demographic data of the patients and the preoperative HR, SBP, DBP and MAP as shown in table 1.

Table 1: Demographic variables and preoperative haemodynamic values

Variables	Group I (n=30)	Group II (n=30)	P value
Age in years	44.27 ± 7.15	41.53 ± 7.12	0.143
Weight in kg	54.13 ± 4.56	54.13 ± 3.53	0.234
Heart rate	95.90 ± 17.30	94.73 ± 15.51	0.784
SBP	123.20 ± 8.47	122.0 ± 8.67	0.589
DBP	82.20 ± 8.64	81.13 ± 8.63	0.634
MAP	95.87 ± 6.45	94.76 ± 7.16	0.530

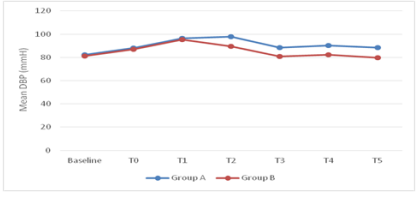
Fig. 1: Mean Systolic Blood Pressure
Graph 1: mean systolic blood pressure



T0- spontaneous respiration, T1- at reversal, T2- 2 mins after giving study medication, T3- 1 min after extubation, T4- 3 mins after extubation, T5- 5 mins after extubation

Baseline values were comparable in both groups. The increase in SBP at spontaneous respiration (T0) and at reversal (T1) was comparable in both groups. SBP fell from T2 to T5 in both groups i.e. after administration of study medication. The SBP was higher in group A than group B and the difference was statistically significant. ($P < 0.05$).

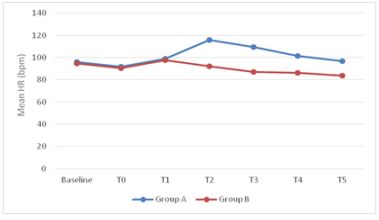
Fig. 2: Mean Diastolic Blood Pressure



T0- spontaneous respiration, T1- at reversal, T2- 2 mins after giving study medication, T3- 1 min after extubation, T4- 3 mins after extubation, T5- 5 mins after extubation

Baseline DBP was comparable in both the groups. Rise in DBP was seen at T0 and T1 in both the groups but the difference between group A and group B was statistically insignificant. Fall in DBP was seen in both the groups after study drug administration i.e. from T2 to T5. At all the points from T2- T5, DBP was lower in group A than group B and the difference was statistically significant.

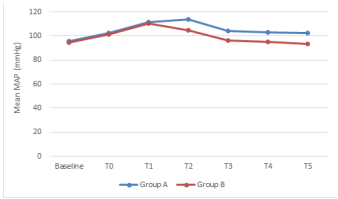
Fig. 3: Mean Heart Rate



T0- spontaneous respiration, T1- at reversal, T2- 2 mins after giving study medication, T3- 1 min after extubation, T4- 3 mins after extubation, T5- 5 mins after extubation

it remained high till T5. HR was higher in group A as compared to group B.

Fig. 1: Mean of Mean Arterial Pressure



T0- spontaneous respiration, T1- at reversal, T2- 2 mins after giving study medication, T3- 1 min after extubation, T4- 3 mins after extubation, T5- 5 mins after extubation

Rise in MAP was seen in both the groups at T0 and T1 but the difference between group A and group B was statistically insignificant. Fall in MAP was seen in both the groups from T2-T5 that is after study drug administration and the fall in MAP was more group B as compared to group A.

DISCUSSION

Tracheal extubation is performed usually with the patient in a light stage of anaesthesia and produces significant increases in heart rate and arterial pressure which persist into the recovery period.5,6,7. 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 fentanyl, labetalol, propofol 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.[8]

Our study was done on 60 ASA grade I and II patients selected for elective abdominal hysterectomy under general anaesthesia to compare the clinical efficacy of esmolol (1.5 mg/kg) vs lignocaine(1mg/kg) in attenuating the haemodynamic responses to extubation.

Lignocaine has been used with apparent good effect to suppress not only the cardiovascular response to extubation but also the coughing associated with the presence of an endotracheal tube.6Esmolol, a beta-adrenergic antagonist, has a rapid onset and extremely short duration of action (t = 9 min),9therefore an ideal drug for preventing acute increases in HR and SBP.

A study was done by savitha et al10 to estimate the difference in hemodynamic and cough response to orotracheal tube extubation with saline (control group), I.V lignocaine 0.5mg/kg and I.V lignocaine 1mg/kg and to evaluate the comparative efficacy between the groups. They concluded that lignocaine 1mg/kg was better than 0.5 mg/kg in attenuating the haemodynamic responses to extubation. Therefore, we chose lignocaine 1mg/kg in our study.

The effect of different strength bolus doses of esmolol 0.5 mg/kg, mg/kg, 1.5 mg/kg. 2 mg/kg) was studied by Wang, YQ et al11 in 2003 who found that high doses of esmolol (2 mg/kg) cause bradycardia and hypotension and lower doses do not control stress responses so he concluded that 1.5 mg/kg, not only controlled cardiovascular responses but also had no side effects.
In a study done by dyson et al1 in 40 ASA grade I and II patients posted for elective noncardiac surgery it was found that doses of 1mg/kg were insufficient to effectively block increases in SBP. A larger dose of 1.5 mg/kg blocks the maximal increase in HR and SBP. Doses of 2mg/kg produce significant (> 20%) decreases in SBP which is undesirable. Therefore, we chose 1.5 mg/kg as a bolus dose at reversal to attenuate the haemodynamic effects at extubation.

Our study demonstrated that esmolol was able to attenuate the increase in SBP, MAP and HR during extubation better than lignocaine.

Similar to our study O'Dwyer JP et al2 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. Muzzi DA et al12 in 1990 also demonstrated that a loading dose of esmolol 500µg/kg followed by an infusion of 50-300 µ/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. Although the doses of esmolol were different in our study, we found similar results with our observation.

A study was done by Habib et al13 in 2012 where they compared the clinical efficacies of fentanyl, esmolol and lidocaine in attenuating heamodynamic responses to endotracheal intubation and extubation in 120 patients. The heart rates, systolic and diastolic arterial blood pressure values after intubation and extubation at 1st, 3th, and 5th minutes were significantly lower in esmolol group when compared to fentanyl and lidocaine groups (P< 0.05). The results Were similar to our study.

In 2015 nagrale et al14 did a prospective randomized comparative study on haemodynamic responses to extubation with lignocaine, esmolol and propofol. 90 patients of ASA grade I/II were included in the study..Group L received 2% i.v. lignocaine 1mg/kg 2 mins prior to extubation, group E received i.v. esmolol 1.5 mg/kg 2 mins prior to extubation and group P received proppfol 0.5 mg/kg 2 mins prior to extubation They concluded that esmolol and propofol were more effective in attenuating rise in systolic blood pressure, diastolic blood pressure and mean blood pressure as compared to lidocaine. Our results were comparable to this study and esmolol attenuated haemodynamic parameters better than lignocaine at extubation.
In 2017 Acharya Narayan et al15 did a study on Comparative evaluation of esmolol, Nitroglycerine and Diltiazem on Attenuation of the Cardiovascular Responses to Tracheal Extubation in 120 patients of ASA grade I/II. Group A received 1mg/ kg of esmolol intravenously, Group B received 1µg/kg of nitroglycerine intravenously, Group C received 0.2mg/ kg of diltiazem intravenously and group D received normal saline (placebo). These agents were administered one minute after reversal. They concluded that Esmolol was more effective in attenuating rise in systolic blood pressure, diastolic blood pressure and mean blood pressure when compared to nitroglycerine and diltiazem. This was similar to our study.

In 2018 shreshtha et al8 did a randomized, double blind study on 60 patients of ASA grade I and II requiring general anaesthesia for elective surgery. GroupI received a bolus dose of esmolol 1.5 mg/kg and Group II received lidocaine 1 mg/kg. 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 .In Group II there was significant increase in SBP at the time of extubation as compared to the value at the end of surgery . They concluded that Esmolol (1.5 mg/kg) given 3 min before tracheal extubation is better than lignocaine(1mg/kg) in attenuating the haemodynamic response to extubation. We had the same results as this study.

In a study involving hypertensive patients done by fujii Y et al16, it was reported that 1 mg kg-1 lidocaine and 0.2 mg kg-1 diltiazem did not prevent the increase in heart rate and mean arterial pressure at extubation. In a study comparing lidocaine to verapamil, it was concluded that lidocaine infusion during intubation suppressed tachycardia and hypertension, but it was insufficient to suppress the overall sympathetic response and to eliminate the effects of increased plasma catecholamine concentrations at extubation. This was similar to our study of lignocaine not being able to attenuate the rise in BP and HR.[48]

Chhabra B et al17 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 earlier administration of study drug in their study while we gave the drug at the time of reversal.

Bidwai AR et al6 in 1979 observed that lidocaine 1mg/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 similar to our study.
A prospective randomized study was done by shruti et al18 in 2015 60 patients undergoing elective laparoscopic cholecystectomy. In Group A, patients received 6 ml normal saline as bolus over 10 min followed by 6 ml/h infusion whereas in Group B, patients received preservative free 2% lignocaine 1.5 mg/kg IV bolus administered over a period of 10 min and thereafter an infusion at a rate of 1.5 mg/kg/h. The rise in pulse rate (PR) and mean arterial pressure (MAP) were less in Group B as compared to the Group A during intubation as well as during extubation. This was contrary to our study as in our study lignocaine was not able to attenuate the rise in heart rate. This difference could be due to increased dose of 1.5 mg/kg of lignocaine used in their study whereas we used only 1mg/kg.

In our study none of the patients suffered the side effects of drug allergy, nausea, vomiting, laryngospasm, hypotension or bradycardia during tracheal extubation.

Thus, it can be inferred that problems associated with extubation, emergence and recovery are more common than problems associated with intubation. Esmolol IV is preferred for attenuation of haemodynamic responses when compared IV lignocaine (2%) 1 mg/kg.

CONCLUSION

We found that Esmolol in a dose of 1.5 mg/kg was more effective in controlling the SBP, DBP and HR than lignocaine in a dose of 1mg/kg at extubation and post extubation. No adverse cardiovascular effects such as hypotension, bradycardia or arrhythmias were seen in any of our study patients. We conclude that esmolol effectively controls arterial pressure and heart rate when given as i.v. bolus in a dose of 1.5 mg/kg just before extubation whereas lignocaine is not as effective in controlling arterial pressure and heart rate when given as an i.v. bolus as a dose of 1mg/kg just before extubation.

However, caution should be taken when using bolus doses of esmolol during extubation unless the patient has received atropine or glycopyrrolate (as part of reversal of neuromuscular blockade) because tracheal stimulation in presence of beta- blockade may potentially produce profound bradycardia.

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