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Research Article

Comparative study on Haemodynamic response to extubation: Attenuation with Lignocaine, Esmolol, Propofol

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ABSTRACT

Background: Endotracheal extubation is an unpredictable and tricky part of anaesthetic management. Elevation in blood pressure and heart rate due to extubation are brief but may have detrimental effects. Hence there should be an effective means of attenuating sympathetic responses to tracheal extubation. Many strategies have been advocated to minimize these hemodynamic adverse responses. Among the recommended procedures i.v. lignocaine, fentanyl and esmolol appear to fulfil the above mentioned criteria.
Methods: This prospective randomized study was done on 90 patients to evaluate haemodynamic effects of intravenous Propofol, Lignocaine, Esmolol given two minutes prior to extubation.
Results: Heart rate, Systolic, Diastolic and Mean blood pressure decreased significantly to Esmolol 1.5mg/kg and propofol 0.5 mg/kg 2 minutes prior to extubation. With lignocaine there was an initial rise in blood pressure. Lignocaine, Esmolol and Propofol were able to attenuate cough and strain of extubation in > 90% of the patients.
Regarding Esmolol, our study coincided with similar studies done by different authors but we found that esmolol in doses of 1.5mg/kg showed better results to control haemodynamic response during extubation. Sedation score was a little high in Propofol group. Extubation scoring was good with all the three drugs.
Conclusions: Esmolol IV is preferred for attenuation of haemodynamic responses when compared with IV propofol 0.5 mg/kg and IV lignocaine (2%) 1 mg/kg as the attenuation effect is elicited immediately.

Keywords: Lignocaine, Propofol, Esmolol, Extubation, Haemodynamics

INTRODUCTION

Asterion is the confluence of the temporal, occipital and endotracheal intubation & extubation is an unpredictable and tricky part of anaesthetic management. King et al described circulatory responses to laryngeal and tracheal stimulation following tracheal intubation and extubation as reflex sympathoadrenal stimulation.[1] Even though the elevation in blood pressure and heart rate due to extubation are brief, they may have detrimental effects in high risk patients.

Some author's in fact consider the extubation as one of the greatest risk phase in surgical patients with coronary artery disease and intracranial aneurysms. Although the response may be transient, it is variable, significant, and often persistent. Intubation & extubation may be required during mechanical ventilation & many of these patients are critically ill and at increased risk. Hence there should be an effective means of attenuating sympathetic responses to tracheal extubation.

Many strategies have been advocated to minimize these hemodynamic adverse responses such as: Block of superior laryngeal nerve, fentanyl, morphine, lignocaine, β-blockers, calcium channel blockers, hydralazine, propofol, etc. Recommendations are manifold but the technique, besides minimizing the cardiovascular responses to extubation must also satisfy the following requirements. It must be applicable universally and easily, prevent impairment of cerebral blood flow, should neither be time consuming nor affect the duration or modality of ensuing anaesthesia.

Among the recommended procedures i.v. lignocaine, fentanyl and esmolol appear to fulfil the above mentioned criteria. Large doses of fentanyl may cause unwanted side effects; intravenous lignocaine has shown variable results. Esmolol is an ultra-short acting β-blocker and has been consistently associated with control of pressor response to extubation. The present study was undertaken to determine the comparative efficacy of i.v.2% lignocaine 1 mg/kg bolus, i.v. esmolol 1.5 mg/kg bolus & i.v. propofol 0.5 mg/kg bolus in attenuating the sympathetic responses to tracheal extubation when administered 2 minutes prior to endotrachael extubation.

Aim and objectives

1. To evaluate the haemodynamic effects of intravenous Propofol, Lignocaine, Esmolol given two minutes prior to Extubation.
2. To compare efficacy of I.V. Lignocaine, I.V. Esmolol, and I.V. Propofol in attenuating cardiovascular response to Extubation.
3. To observe any side effects or complications during study, in all study groups.

METHODS

This prospective randomized study was done in department of anaesthesiology, "Acharya Vinobha Bhave Rural 1-hospital" attached to "Jawaharlal Nehru Medical College" Sawangi (Meghe), Wardha, of "Datta Meghe Institute of Medical Sciences University" Wardha during the period of May 2008 to December 2010.

This study was conducted on 90 adult patients who were scheduled for major surgeries. Approval from institutional ethical committee & valid written informed consent from patients was obtained.

Patients were divided in three groups of 30 patients each.

1. Group L: patients received 2% i.v. Lignocaine l mg/kg {Preservative free) 2 minutes prior to extubation.
2. Group E: patients received i.v. Esmolol 1.5 mg/kg 2 minutes prior to extubation.
3. Group P: patients received i.v. Propofol 0.5 mg/kg 2 minutes prior to extubation.

Inclusion criteria

ASA grade 1 & II. Age between 20 to 50 years. Mallampatti class I & II.

Exclusion criteria

1. Patient Refusal.
2. Allergic reaction to drugs used for study.
3. Patient with difficult airways &history of bronchospasm.
4. Patients with history of Cardiovascular diseases

Pre anaesthetic protocol was followed. Baseline vitals recorded.

Patients were premedicated with Glycopyrolate 4 ug/kg, Midazolam 0.04 mg/kg, Butorphenol 0.02 mg/kg. Preoxygenated. Induced with Thiopentone sodium 2.5% Intubation was done on Vecuronium 0.1 mg/kg. Maintenance of anaesthesia was done on 40% O2, 60% N2O, Halothane and Vecuronium. Vital parameters were recorded throughout the procedure. Halothane was discontinued 5 minutes before the end of surgery and Nitrous oxide just before reversal of neuromuscular blockade with Neostigmine 0.05mg/kg, Glycopyrolate 0.008 mg/kg intravenously.

Extubation

The study drug was given 2 minutes prior to Extubation. Patients were given 100% Oxygen between injections of drug and tracheal Extubation. After gentle & thorough oropharyngeal suction endotracheal extubation was done. Quality of Extubation was scored on 4 point scale as suggested by Eshak (0-No cough or strain, 1-Moderate coughing, 2- High degree of coughing or straining, 3-Poor extubation with larygospasm).

Monitoring of parameters

Heart rate, Systolic and Diastolic blood pressure and Mean arterial pressure was monitored and recorded just before study drug administration (T-O), before extubation (T-1), one (T-2), three (T-3),five (T-4) and ten (T-5) minutes after Extubation. ECG and Oxygen saturation was continuously monitored. Complications if any were noted during the study in all the three groups.

Sedation Scoring done by using 5 point Sedation scoring scale:
All three groups were compared in respect tohaemodynamic parameters as, Systolic blood pressure, Diastolic blood pressure, Mean arterial pressure, just before study drug administration (TO) [i.e. baseline in our study], and before extubation (T1), one (T-2), three (T-3),five (T-4) and ten (T-5) minutes after Extubation.

Statistical analysis

Statistical analysis was done using SPSS version 14.0 and Graph Pad Prism 4 for windows. One way ANOVA, Student's unpaired t test and paired t test was applied for numerical data like haemodynamic etc. and chi-square test was used for comparing frequencies. P-value of <0.05 was considered significant whereas the p-value of >0.05 was considered non-significant.

RESULTS

In this study the mean age of the patients was 34.73±9.06 years in group L, 35.10±8.81 years in group E and 33.23±9.42 years in group P which were comparable and the difference is statistically not significant. Maximum numbers of patients were in the age group of 31-40 years in group L and E and in group P in the age group of 20-30 years. P-value=0.54 which is not significant. The gender distributions of patients in all the groups were comparable and the difference is not statistically significant. Maximum numbers of patients were in the weight group of 51-60kg in all groups.

Heart rate--Before administration of study drug, heart was 105/min in Group L which further increased to 107 just before extubation i.e. after giving study drug. Heart rate increased significantly in Lignocaine group (L) before extubation, one minute after extubation, three minutes after extubation and decreased at 5 and 10 minutes after extubation.

Heart rate decreased markedly in Esmolol group E (from 111 to 77) and Propofol group P (from 94 to 87) (p<0.05) up to 10 minutes after study drug is given. (Table 1, Figure 1)

Systolic blood pressure increased significantly in group L before extubation, one minute after extubation, and three minutes after extubation and decreased 5 to 10 minutes after extubation. Systolic blood pressure decreased significantly in group E and P (p<0.05) up to 10 minutes after study drug was given (Table 2, Figure 2).

Diastolic blood pressure increased significantly in group L before extubation, one minute after extubation and three minutes after extubation and decreased 5 to 10 minutes after extubation. It decreased significantly in group E and group P (Table 3, Figure 3).

Mean arterial pressure increased significantly in group L before extubation, one minute after extubation, three minutes after extubation and slightly increased in 5 minutes which is non-significant and slightly decreased at 10 minutes after extubation. It decreased significantly in Group E and Group P (Table 4, Figure 4).

Sedation score

All the three groups were comparable regarding sedation score (p<0.05). Propofol caused more sedation in 9(30%) patients, in lignocaine group sedation was seen in 3(10%) patients and in esmolol group there was no sedation in any patients after 10 mins (Table 5, Figure 5).

Quality of extubation was scored by 4 point scale as suggested by Eshak. All the three groups were comparable regarding quality of extubation (p>0.05). Hence all the three drugs i.e. lignocaine, esmolol and propofol were able to attenuate cough and strain of extubation in > 90% of the patients. Oxygen saturation was well maintained in all the patients, irrespective of any group. No ECG changes were observed in any of the patients of the three groups (Table 6, Figure 6).

Table 1: Heart rate in the three groups at different time intervals when compared to T-0.

Group	Before giving drugT0	Before extubation T-1	1min after extubation T-2	3min after extubation T-3	5min after extubation T-4	10minsafter extubation T-5	P value
Group L	105.30 ±6.63	109.53 ±6.19	111.73 ±5.55	114.43 ±5.78	106.00 ±5.19	100.00 ±4.57	P<0.05 S
Group E	111.46 ±5.14	86.60 ±7.24	82.06 ±6.48	79.80 ±5.90	78.73 ±4.50	77.33 ±4.49	P<0.05 S
Group p-	94.33 ±4.	84.93 ±3.88	86.93 ±3.59	87.60 ±3.87	88.80 ±3.46	87.60 ±4.27	P<0.05 S

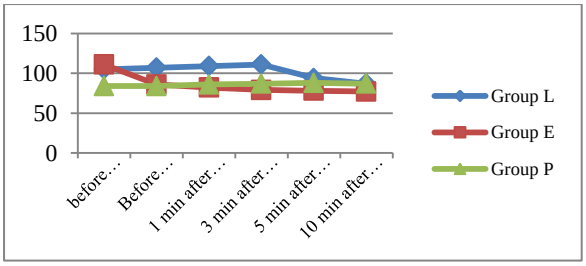


Figure 1: Heart rate in the three groups at different times intervals when compared to T-0.

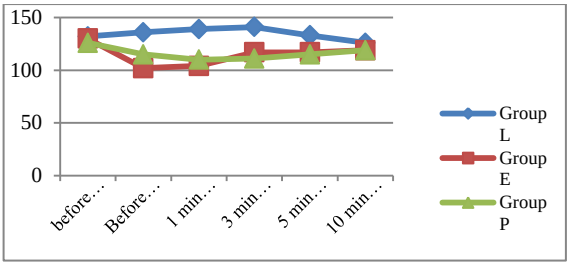


Figure 2: Systolic blood pressure in the three groups at different time intervals when compared to T-0.

Table 2: Systolic blood pressure in the three groups at different time intervals when compared to T-0.

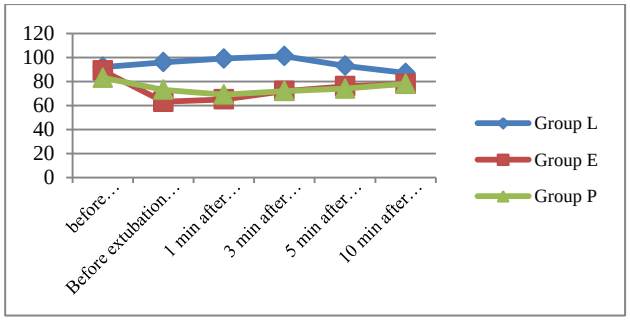
Group	Before giving drug T-0	Before extubation T-1	1min after extubation T-2	3min after extubation T-3	5min after extubation T-4	10min after extubation T-5	P value
Group L	132.33 ±6.58	136.20 ±5.80	139.06 ±5.84	141.46 ±5.77	133.00 ±5.19	126.80 ±4.56	P<0.05 S
Group E	130.00 ±3.60	102.20 ±3.25	104.80 ±3.66	117.73 ±5.13	117.40 ±4.95	119.6 ±5.97	P<0.05 S
Group P	126.06 ±3.80	115.86 ±7.46	110.13 ±4.54	111.60 ±2.84	115.13 ±2.81	119.46 ±1.96	P<0.05 S

Table 3: Diastolic blood pressure in the three groups at different time intervals when compared to T-0.

Group	Before giving drugT0	Before extubation T-1	1min after extubation T-2	3min after extubation T-3	5min after extubation T-4	10minsafter extubation T-5	P value
Group L	92.26 ±6.70	96.20 ±5.8	99.06 ±5.55	101.40 ±5.80	93.6 ±5.19	87.00 ±4.6 3	P<0.05 S
Group E	89.33 ±3.90	63.33 ±4.40	65.20 ±3.50	72.20 ±5.10	76.46 ±4.94	78.46 ±6.39	P<0.05 S
Group P	83.33 ±4.21	73.66 ±6.62	69.86 ±3.67	72.40 ±2.84	74.66 ±2.84	78.06 ±3.08	P<0.05 S

Table 4: Mean arterial pressure in the three groups at different time intervals when compared to T-0.

Group	Before giving drug T0	Before extubation T-1	1min after extubation T-2	3min after extubation T-3	5min after extubation T-4	10minsafter extubation T-5	P value
Group L	105.30 ±6.63	109.53 ±6.19	111.73 ±5.55	114.43 ±5.78	106.00 ±5.19	100.00 ±4.57	P<0.05 S
Group E	102.86 ±3.46	76.16 ±3.67	78.26 ±3.40	85.33 ±4.97	90.00 ±4.77	92.20 ±6.24	P<0.05 S
Group P	97.53 ±3.91	87.36 ±7.52	83.06 ±3.63	85.40 ±2.48	87.93 ±2.66	91.73 ±2.50	P<0.05 S



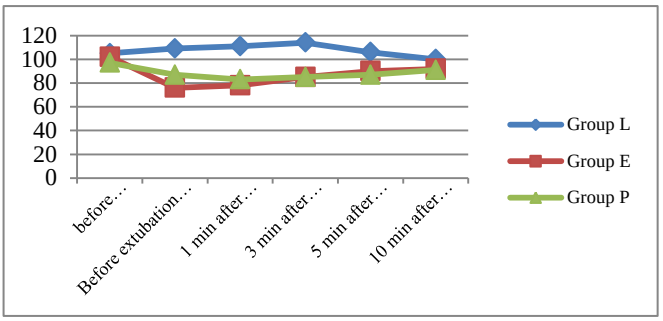


Figure 3: Diastolic blood pressure in the three figure 4: mean arterial pressure in the three groups groups at different time intervals when compared at different time intervals when compared to T-0.

Table 5: Percentage of patients sedated after extubation.

Sedation Score	Group L	Group E	Group P	
Present	3 (10%)	0(0.0%)	9 (30%)	142-value 12.12 S. P<0.05
Absent	27 (90%)	30(100%)	21(70%)	

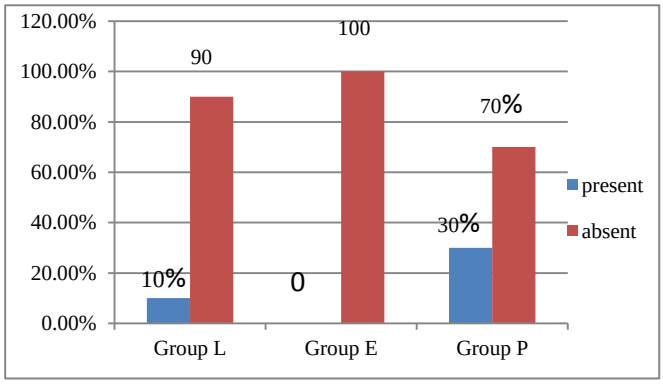


Figure 5: Percentage of patients sedated after extubation.

Table 6: Extubation score in the three groups.

Extubation	Group L	Group E	Group P	Total	1.12-value
0-No cough Or strain	28 (93.33%)	29 (96.66%)	30 (100%)	87	1.07 p-value = 0.78 NS, p>0.054
1-Moderate Coughing	2 (6.67 67%)	1 (3.34%)	0 (0%)	3	
2-High degree of Coughing	-	-	-	-	
3-Poor extubation with laryngo-spasm	-	-	-	-	

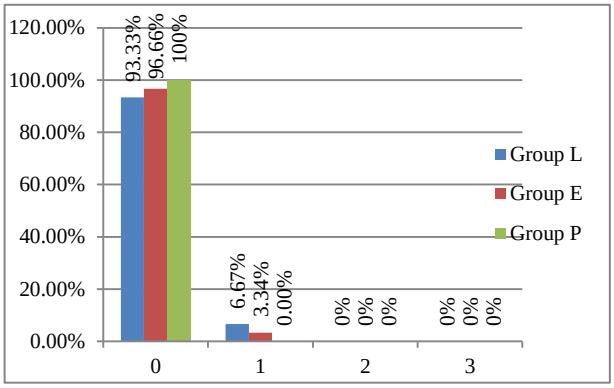


Figure 6: Extubation score in the three groups.

DISCUSSION

Tracheal intubation receives much attention, and tracheal extubation has received relatively little emphasis. The scope and significance of problems occurring after tracheal extubation are real[2]. It often provokes hypertension and tachycardia due to reflex sympathetic discharge caused by pharyngeal and laryngeal stimulation. This stimulation is associated with increase in plasma epinephrine concentration[3]. The haemodynamic responses to tracheal extubation are probably of little consequence in healthy individuals, but may be more severe and more hazardous in hypertensive patients.

Adverse outcomes involving the respiratory system comprise the single largest class of injury reported in the ASA Closed Claims Study.[4] Some studies have

documented a 4%-9% incidence of serious adverse respiratory events in the immediate postextubation period and preventable anaesthesia-related etiologies were noted by Ruth et al, Mathew et al.[5-7] Perhaps a greater percentage of patients experience postextubation difficulties but do not require reintubation. Reasons for tracheal reintubation in the intensive care setting may differ, but the reported incidence in that area is about 4%.[8]

Anaesthesiologists recognize the immediate postextubation period as vulnerable. Events such as laryngospasm, aspiration, inadequate airway patency or inadequate ventilation can occur and frequently result in hypoxemia. Although such hypoxemia is most often corrected within minutes, it can rapidly result in serious morbidity.

To know the implications of tracheal extubation & related complication (haemodynamic response to extubation, coughing, bucking etc.) we undertook this study.

About patients age group, gender distribution & weight

In our study the mean age of the patients was comparable and the difference is not significant.

Gender distributions of patients in all groups were comparable and the difference is not statistically significant.

Mean weight of the patients was not found significant. Maximum numbers of patients were 51-60 kg in all the groups.

About heart rate changes

In our study heart rate decreased immediately in group E (Esmolol) and group P (Propofol) ($p<0.05$) after study drug is given and remained stable at that level up to 10 mins after extubation. It increased significantly in Lignocaine group L up to three minutes after extubation and decreased at 5 and 10 minutes after extubation.

About systolic and diastolic BP changes

In our study the systolic and diastolic blood pressure decreased significantly in Group E and Group P ($p<0.05$) up to 10 minutes after study drug was given but it increased significantly in Group L and decreased 5 to 10 minutes after extubation.

Bidwai AV et al concluded that Patients receiving lidocaine 1 mg/kg 2 mins before extubation did not sustain a significant elevation in systolic or diastolic blood pressure or pulse rate at or after extubation or in the recovery room. This is contrary to our study.[9]

Our findings of haemodynamic response to extubation attenuated by esmolol are consistent & comparable to study conducted by Muzzi DA, Black S, et al.[10] They compared efficacy of esmolol and labetalol in treating increase in blood pressure during emergence and recovery from anaesthesia after intracranial surgery. They found both esmolol and labetalol were equally effective in controlling systolic blood pressure on emergence and in the recovery room in patients undergoing intracranial surgery. Our study is also consistent & comparable to study done by Dyson A, Isaac PA et al.[11] By a Study conducted by Fuhrman TM, Ewell CL et al, esmolol significantly controlled the heart rate and blood pressure responses to emergence and extubation which is at par with our study.[12]

Nishina K, Maekawa N, et al did three studies on attenuation of haemodynamic response to extubation.[13-15] They studied the effect of Fentanyl, IV prostaglandin E-1 and prostaglandin lignocaine combined. They found the combination had superior results.

Conti J, Smith D observed that propofol caused a dose related decrease in blood pressure when given at extubation in patients of coronary bypass grafting surgery and that Propofol is safe and reduced chance to myocardial ischemia due to less haemodynamic disturbances.[16]

Diltiazem and lidocaine was tried in hypertensive patients by Fujii Y, Saitoh Y, et a1.[17] This study was undertaken to compare the efficacy of combined diltiazem and lidocaine with each drug alone in suppressing the hemodynamic changes during tracheal extubation. They found that Hemodynamic changes during tracheal extubation were less in patients receiving diltiazem plus lidocaine than in those receiving diltiazem or lidocaine as a sole medicine.

Our study can be compared with the study conducted by Balbir Chhabra, Naveen Malhotra et a1.[18] Their study drugs were similar to ours. None of the three drugs in their study was able to attenuate hypertensive/tachycardiac response immediately after extubation ($p<0.05$). However, one minute after extubation, hypertensive response was attenuated by propofol and tachycardiac response by esmolol. Lignocaine was not effective in attenuating hypertensive as well as tachycardiac responses until three minutes after extubation. Results in our study for esmolol and propofol were contrary to this study as attenuation of haemodynamic response to extubation occurred significantly just after extubation in esmolol and propofol group. Regarding quality of extubation author has similar result as we have found in our study which means all the three drugs were able to attenuate cough or strain of extubation in approximately 90% patients.

Wang YQ, Guo QL,et al in 2003 concluded in their study that esmolol of 1.5 mg/kg may not only control cardiovascular responses more effectively to the tracheal extubation, but also has no side-effects.[19] Our study is comparable with this study in respect to use of esmolol 1.5 mg/kg which control cardiovascular responses more effectively to tracheal extubation, and also has no side effects.

The study conducted by Sarabjit Kaur, Asha Gupta, et al in 2006 concluded that propofol administered before tracheal extubation prevented extubation related complications. Results of this study are comparable and consistent with our study although they used propofol 1 mg/kg and in our study we used 0.5mg/kg.[20]

Our study is comparable in respect to use of IV lignocaine to the study conducted by Venkatesan T, Korula G.[21] In their study forty-one patients received 4% lignocaine in the endotracheal tube cuff after intubation and 41 patients received IV lignocaine 1.5 mg/kg before extubation. Coughing was assessed by a scale of 3 at the time of extubation. Hemodynamic parameters recorded at 1-minute interval after extubation for 5 minutes. In conclusion, endotracheal tube cuff lignocaine was not superior to 1.5 mg/kg IV lignocaine in attenuating coughing and hemodynamic changes during extubation.

Our study is comparable in respect to use of esmolol and findings are consistent with study conducted by Kovac AL, Masiongale A.[22] They concluded that although esmolol 1.5 mg/kg, IV was more effective than nicardipine 0.03 mg/kg IV for attenuating the heart rate response to extubation, nicardipine was more effective in controlling the BP response.

About MAP changes

Mean Arterial pressure decreased significantly in Group E and moderately in Group P ($p<0.05$) up to 10 minutes after study drug is given which is statistically significant. In group L, it increased significantly before extubation, one minute and three minutes after extubation but slightly decreased at 10 minutes.

About sedation percentage

Propofol caused more sedation (30%), in lignocaine group it was 10% of patients but in esmolol group there was no sedation in any patients after 10 mins.

About extubation scoring:All the three groups were comparable regarding quality of extubation ($p>0.05$). Hence all the three drugs i.e. lignocaine, esmolol and propofol were able to attenuate cough and strain of extubation in > 90% of the patients. Our observation is at par with the study of Venkatesan T, Korula G where lignocaine 1.5 mg/kg IV attenuated coughing.[21]

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 with IV propofol 0.5 mg/kg and IV lignocaine (2%) 1 mg/kg. IV propofol 0.5 mg/kg causes sedation, in postoperative period.

With IV lignocaine (2%) l mg/kg, attenuation of haemodynamic response to extubation occurs 5 minutes after administration of drug whereas with Esmolol the attenuation effect is elicited immediately.

CONCLUSION

From the observations and results of our study it is concluded that, IV esmolol 1.5 mg/kg when given 2 minutes prior to extubation, effectively attenuates haemodynamic response (hypertension and tachycardia) to extubation immediately and remained effective till 10 minutes post extubation, without any side effects.

Esmolol IV is preferred for attenuation when compared with IV propofol 0.5 mg/kg and IV lignocaine (2%) 1 mg/kg 2 minutes prior to extubation on following grounds:

1. IV propofol 0.5 mg/kg when given 2 minutes prior to extubation attenuates haemodynamic response to extubation immediately and satisfactorily and remained effective till 10 minutes post extubation, but causes sedation in postoperative period.

2. IV lignocaine (2%) 1 mg/kg when given 2 minutes prior to extubation is not effective immediately and attenuation of haemodynamic response to extubation occurred after 5 minutes postextubation period.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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