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COMPARATIVE STUDY OF THE HEMODYNAMIC EFFECTS OF ESMOLOL AND LIDOCAINE IN ATTENUATION OF HAEMODYNAMIC RESPONSES TO TRACHEAL EXTUBATION IN NEUROSURGICAL PATIENTS

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Abstract

Background: To reduce airway and circulatory responses during extubation, various pharmacological and non-pharmacological methods have been used such as opioids, inhalational agents, local anaesthetics, vasodilators, alpha blockers, beta blockers, and calcium channel blockers. Present study was aimed to compare the hemodynamic effects of esmolol and lidocaine in attenuation of haemodynamic responses to tracheal extubation in

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neurosurgical patients. **Material and Methods:** Present study was single centric, observational, prospective, comparative study, conducted in patients with ASA 1 & 2, undergoing neurosurgical procedure (elective and emergency) with invasive blood pressure monitoring. Patients were divided in two group as Group 1 (Esmolol, n=30) & Group 2 (Lignocaine, n=30). **Results:** No significant difference was seen in the age wise distribution, gender wise distribution, mean weight & ASA grade distribution of patients enrolled in both groups. No significant difference in heart rate was seen among patients in both the group at baseline and at pre reversal stage. Average heart rate was significantly higher among patients in lignocaine after pre reversal stage from min 1 to 15 min. No significant difference in SBP was seen among patients in both the group at baseline and at pre reversal stage. Average SBP was significantly higher among patients in lignocaine after pre reversal stage from min 1 to 15 min. Nausea – vomiting were the two most common side effect seen among patients in both the group. No significant difference was seen among the reported side effect. Majority of patients in both the group has no coughing at extubation. No significant difference in the quality of extubation was seen among patients in both group **Conclusion:** No difference in the side effect was seen among patients in both group & majority of patients has smooth extubation with no coughing episode.

Keywords: lignocaine, esmolol, haemodynamic responses, tracheal extubation, neurosurgery

Introduction

Anaesthetizing a patient with general anaesthesia necessitates special care in terms of maintaining the airway. When surgical intervention is completed and an endotracheal tube is no longer required for airway safety, extubation is performed. It is one of the most unpleasant states experienced during general anaesthesia. It is almost always associated with changes in hemodynamics. Mechanical and chemical particles, like intubation, cause respiratory and cardiovascular reflexes from stimulated airway receptors, particularly the larynx, trachea, and bronchi.[1]

Intracranial surgery necessitates an anaesthetic method that ensures hemodynamic stability and rapid recovery to allow for immediate neurological evaluation. Because of sympathetic discharge caused by epipharyngeal and laryngeal stimulation, tracheal extubation is always associated with hemodynamic changes. The stimulation of the laryngopharynx is associated with a reflex increase in sympathetic activity, which results in hemodynamic changes.[2,3] These hemodynamic changes, which manifest as an increase in heart rate and arterial blood pressure, are typically variable, transitory, and unpredictable.[1]

To reduce airway and circulatory responses during extubation, various pharmacological and non-pharmacological methods have been used. Various drugs, such as opioids, inhalational agents, local anaesthetics, vasodilators, alpha blockers, beta blockers, and calcium channel blockers, have been used in trials to reduce the hemodynamic and stressor responses during tracheal extubation.[4] Present study was aimed to compare the hemodynamic effects of esmolol and lidocaine in attenuation of haemodynamic responses to tracheal extubation in neurosurgical patients.

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Material And Methods

Present study was single centric, observational, prospective, comparative study, conducted in Department of Anaesthesiology, at XXX medical college & hospital, XXX, India. Study duration was of 2 years (October 2020 to September 2022).

Inclusion criteria

- Patients with ASA 1 & 2, undergoing neurosurgical procedure (elective and emergency) with invasive blood pressure monitoring, willing to participate in present study

Exclusion criteria

- Patients with any contraindication for study drug
- Patient not giving consent for study
- Patients with bronchial asthma
- Patients with ASA 3 & 4

The study was initiated after obtaining approval from the institutional ethics committee and department of ophthalmology. A written informed consent was taken from the patients when they were stable and ready for enrolment into the study. On enrollment demographic & clinical details were noted.

Patients were divided in two groups by blinding during random allocation

1. Group L: patients received 2 % Lidocaine 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.

Heart rate, Systolic and Diastolic blood pressure and Mean arterial pressure was monitored and recorded just before study drug administration (T-O) after extubation 1 to 10 min and fifteenth min. ECG and Oxygen saturation was continuously monitored. Complications if any were noted during the study in all the two groups. Two groups were compared in respect to haemodynamic parameters such as, Systolic blood pressure (SBP), Diastolic blood pressure (DBP), Mean arterial pressure (MAP)just before study drug administration (TO) [i.e. baseline in our study], and before extubation 1 to 10 min and fifteenth min after extubation. Here BP was monitored through invasive BP monitoring and quality of extubation calculated by 5-point scale.

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Quantitative variables were compared using Paired t-test/Wilcoxon matched paired t test, One Way Analysis of variance (ANOVA) followed by post hoc Tukey's Test or Friedman followed by Dunn's Multiple Comparisons Test was performed depending on the normality of the data. A p value of <0.05 was be considered statistically significant.

Results

In this study 60 patients who underwent elective or emergency surgical procedure were enrolled and were divided in two group as Group 1 (Esmolol, n=30) & Group 2 (Lignocaine, n=30). The average age of patients enrolled in esmolol group was 31.13 ± 13.57 years and those in lignocaine group was 32.2 ± 12.90 years. No significant difference was seen in the

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age wise distribution, gender wise distribution, mean weight & ASA grade distribution of patients enrolled in both groups.

Table 1: General characteristics

	Esmolol	**Lignocaine**	**P value**
Age groups (in years)			
≤ 20	10	5	
21-35	9	14	
36-50	8	7	
>50	3	4	
70-79			
Mean age (mean ± SD)	31.13 ± 13.57	32.2 ± 12.90	1.59 (Mann Whitney test)
Gender			
Male	13	15	0.79 (Fisher test)
Female	17	15	
Other			
Mean Weight (kg)	57.33 ± 9.07	57.26 ± 8.44	0.83 (Unpaired t test)
ASA			
I	29	30	1.0 (Fisher test)
II	1	0	

No significant difference in heart rate was seen among patients in both the group at baseline and at pre reversal stage. Average heart rate was significantly higher among patients in lignocaine after pre reversal stage from min 1 to 15 min.

Table 2: Heart rate (per min) wise comparison among patients in two group

Time period	**Esmolol**	**Lignocaine**	**P value***
Baseline	79.36 ± 6.92	82.23 ± 5.64	0.08
Pre reversal	82.83 ± 6.31	84.26 ± 5.57	0.35
1 min	96.43 ± 5.09	111.9 ± 8.98	0.0001
3 min	92.16 ± 4.70	112.86 ± 3.84	0.0001
5 min	85.76 ± 14.86	103.96 ± 7.89	0.0001
10 min	85.1 ± 3.83	96.6 ± 5.59	0.0001
15 min	81.5 ± 3.94	90.7 ± 3.64	0.0001

No significant difference in SBP was seen among patients in both the group at baseline and at pre reversal stage. Average SBP was significantly higher among patients in lignocaine after pre reversal stage from min 1 to 15 min

Table 3: SBP (mmHg) comparison among patients in two group

Time period	**Esmolol**	**Lignocaine**	**P value**
Baseline	124.86 ± 7.86	126.9 ± 7.69	0.31
Pre reversal	127.92 ± 7.46	125.73 ± 7.89	0.27
1 min	135.43 ± 5.11	150.6 ± 7.19	0.0001
3 min	130.73 ± 5.10	145.56 ± 7.36	0.0001

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5 min	126.5 ± 4.99	136.66 ± 6.66	0.0001
10 min	122.26 ± 5.48	127.16 ± 6.04	0.0017
15 min	116.6 ± 5.92	121.03 ± 5.54	0.0041

* Mann Whitney test

No significant difference in DBP was seen among patients in both the group at baseline, pre reversal stage and 3 min post infusion. Average SBP was significantly higher among patients in lignocaine after pre reversal stage from min 1 and from 5 min to 15 min.

Table 4: DBP (mmHg) comparison among patients in two group

Time period	Esmolol	Lignocaine	P value
Baseline	83.03 ± 4.33	82.90 ± 14.49	0.96
Pre reversal	79.8 ± 3.80	82.03 ± 5.02	0.06
1 min	90.63 ± 2.70	94.7 ± 3.26	0.0001
3 min	89.7 ± 3.45	90.36 ± 2.85	0.42
5 min	82.53 ± 3.64	84.3 ± 3.47	0.049
10 min	78.5 ± 3.43	82.23 ± 3.18	0.0001
15 min	76.03 ± 4.02	79.7 ± 4.00	0.0008

*Mann Whitney test

No significant difference in MBP was seen among patients in both the group at baseline and at pre reversal stage . Average MBP was significantly higher among patients in lignocaine after pre reversal stage from min 1 to 15 min.

Table 5: MAP (mmHg) comparison among patients in two group

Time period	Esmolol	Lignocaine	P value
Baseline	93 ± 4.82	94.2 ± 6.27	0.40
Pre reversal	89.6 ± 2.84	90.7 ± 3.97	0.22
1 min	92.26 ± 3.27	113.86 ± 2.86	0.0001
3 min	89.7 ± 3.35	103.8 ± 5.01	0.0001
5 min	87.76 ± 3.64	95.6 ± 3.47	0.0001
10 min	85.23 ± 3.25	90.7 ± 3.64	0.0001
15 min	83.53 ± 3.81	89.36 ± 3.37	0.0001

*Mann Whitney test

Nausea – vomiting were the two most common side effect seen among patients in both the group. No significant difference was seen among the reported side effect

Table 6: Side effects comparison among patients in two group

Side effect	Esmolol	Lignocaine	P value (Fisher test)
Nausea	4	5	1.00
Vomiting	2	2	1.00
Headache	0	1	1.00
Total	6	7	

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Majority of patients in both the group has no coughing at extubation. No significant difference in the quality of extubation was seen among patients in both group

Table 7: Quality of extubation comparison among patients in two group

Quality of extubation	Esmolol	Lignocaine	P value (Fisher test)
No coughing	23	22	1.00
Smooth extubation, minimal coughing (1 or 2 times)	5	3	0.70
Moderate coughing (3 or 4 times)	2	5	0.42

Discussion

Tracheal extubation in both the critical care and anaesthesia settings is not only an important milestone for patient recovery, but it is also a procedure fraught with complications and failure. Tracheal extubation in both the critical care and anaesthesia settings is not only an important milestone for patient recovery, but it is also a procedure fraught with complications and failure. Because of sympathetic discharge caused by epipharyngeal and laryngeal stimulation, tracheal extubation is always associated with hemodynamic changes. Anesthesia for neurosurgery must ensure hemodynamic stability and rapid recovery to allow for immediate neurological evaluation. It is critical to prevent and control the hemodynamic response to nociceptive stimuli in these patients in order to maintain cerebral homeostasis.

Esmolol is a beta – selective (cardio selective) adrenergic receptor blocking agent with a short duration of action among the various beta blockers (ultra short acting).[5,6] Esmolol has been used as a pre-medication agent for many years. As a result, it is an excellent agent for preventing the acute increases in heart rate and arterial pressure that occur during extubation. Lignocaine is a commonly used drug for pressor response that also has analgesic properties.[1] Lignocaine given as a bolus dose just prior to tracheal intubation[7] or extubation[8] has been shown to reduce the haemodynamic responses associated with these procedures.

The baseline demographic characteristics of patients enrolled in our study were similar to those of patients enrolled in Shrestha S *et al.*[9] study, patients in the esmolol group had an average age of 30.10± 8.31 years, while those in the lignocaine group had an average age of 34.73 ± 10.28 years. Similarly, Nagrale MH[10] reported in his study that the mean age of the patients in the lignocaine group was 34.73 ± 9.06 years and 35.10 ± 08.81 years in the Esmolol group, which were comparable and the difference was statistically insignificant. The majority of patients in both groups were ASA category 1 and had no difference in weight distribution. This was also consistent with the findings of Nagrale MH [10] and Shrestha S *et al.*,[9]

In present study, there was a significant increase in heart rate among patients in the lignocaine group after the pre-reversal stage. This difference remained consistent until the end of the 15-minute period. This showed that there was inadequate attenuation of stress response by lignocaine. This was almost similar to study conducted by Shrestha S *et al.*,[9] where 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 lignocaine group (p=0.000), while the values were not significant in Esmolol Group. Nagrale MH.,[10] reported heart rate

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decreased immediately in Esmolol group after study drug is given and remained stable at that level up to 10 mins after extubation. It increased significantly in Lignocaine group up to three minutes after extubation and decreased at 5 and 10 minutes after extubation.

In present study, systolic, diastolic, and mean blood pressure were similar in both groups at baseline and during the pre-reversal stage, but all significantly increased after the pre-reversal stage until the end of the 15-minute study period. This was also consistent with the findings of Nagrale MH [10] and Shrestha S *et al.*,[9]

Our findings of esmolol-attenuated haemodynamic response to extubation are consistent and comparable to those of Muzzi DA *et al.*,[11] They noted that esmolol and labetalol were equally effective in controlling systolic blood pressure in patients undergoing intracranial surgery upon emergence and in the recovery room. Our findings are also consistent with and comparable to those of Dyson A *et al.*[12] However, Conti J, Smith D discovered that propofol caused a dose-related decrease in blood pressure when given at extubation in patients undergoing coronary bypass grafting surgery, and that propofol is safe and reduces the risk of myocardial ischemia due to fewer haemodynamic disturbances.[13] Wang YQ, Guo QL, and colleagues concluded that esmolol at 1.5 mg/kg not only controls cardiovascular responses to tracheal extubation more effectively, but also has no side effects.[14]

There was no significant difference in the side effects caused by lignocaine and esmolol among patients in either group. Majority of patients in both groups had no coughing during extubation, while a few had mild to moderate coughing that was transient in nature. However, there was no difference in the overall quality of extubation between the two groups of patients. This was also consistent with the findings of Nagrale MH [10] and Venkatesan T, Korula G[15] where lignocaine 1.5 mg/kg IV attenuated coughing.

Based on our findings, IV esmolol, given prior to extubation, effectively reduces the haemodynamic response (hypertension and tachycardia) to extubation immediately and remains effective for 15 minutes after extubation, with no major side effects. There were few limitations of our study, since this was a single centric study including few numbers of patients which could not truly represent the characteristic of whole population. Thus, the generalizability of results is limited. Future study should include large sample size from different centers and region of the country.

Conclusion

Our study thus concludes that among patients in the lignocaine group hemodynamic parameters such as heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure was high after study drug infusion. No difference in the side effect was seen among patients in both group & majority of patients has smooth extubation with no coughing episode.

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References

1. Kucukosman G, Gulhan B A. A comparative analysis of the effects of esmolol, lidocaine, nitroglycerin and placebo on hemodynamic response to extubation, and extubation quality and postoperative pain. Ann Med Res 2020;27(10):2617-24
2. Nishina K, Mikawa K, Maekawa N, Obara H. Attenuation of cardiovascular responses to tracheal extubation with diltiazem. Anesth Analg 1995;80:1217 22.
3. Fuji Y, Saitoh Y, Takahashi S, Tayooka H. Combined diltiazem and lidocaine reduces cardiovascular responses to tracheal extubation and anesthesia emergence in hypertensive patients. Can J Anaesth 1999;46:952 6.
4. Miller RD. Miller‟s Anaesthesia. 6th ed. Elsevier Churchill Livingstone; 2005, 1647
5. Dalton B, Guiney T, Myocardial ischemia from tachycardia and hypertension in coronary heart disease – patients undergoing anesthesia . Ann. Mtg. Boston; American society of Anesthesiology ; 1972 p.201-2.
6. Donegan MF, Bedford RF. Intravenously administered lignocaine prevents intracranial hypertension during endotracheal suctioning. Anesthesiology 1980; 2; 5 16-8.
7. Wang Y M, Chung K C, Lu H F, Huang Y W , Lin KC, Yang LC, *et al.* Lidocaine: The optimal timing of intravenous administration in attenuation of increase of intraocular pressure during tracheal intubation. Acta Anaesthesiol Sin. 2003; 41: 71 – 5.
8. Nishina K, Mikawa K , Takao Y, Shiga M, Maekawa N, Obara H. Prostaglandin E 1, lidocaine, and prostaglandin E1 - lidocaine combination for attenuating cardiovascular responses to extubation. Can J Anaesth. 1997 ;44 :1211 – 4.
9. Shrestha S, Chand MB, Vaidya PR, Thapa P, Shrestha AB. Attenuation of Hemodynamic Response to Tracheal Extubation: Comparison of Esmolol and Lidocaine. Postgraduate Medical Journal of NAMS.2013;13(1):26-30
10. Nagrale MH, Indurkar PS, Pardhi CS. Comparative study on Haemodynamic response to extubation: Attenuation with Lignocaine, Esmolol, Propofol. Int J Res Med Sci 2016;4:144-51
11. Muzzi DA, Black S, Iosasso TJ, Cucchiara RF. Labetalol and esmolol in the control of hypertension after intracranial surgery. Anesth Analg. 1990;70(1):68-71.
12. Dyson A, Isaac PA, Pennant JH, Giesecke AH, Lipton JM. Esmolol attenuates cardiovascular responses to extubation. Anesth Analg 1990; 71: 675 –8.
13. Conti J, Smith D. extubation after cardiac surgery with and without continued sedation. Br J Anaesth. 1998;80(6):834-6
14. Wang YQ, Guo QL, Xie D. Hunan Yi Ke Da Xue Xue Bao. Effects of different doses of esmolol on cardiovascular responses to tracheal extubation. 2003;28(3):259-62.
15. Venkatesan T, Korula G. A comparative study between the effects of J% endotracheal tube cuff lignocaine and 1.5 mg/kg intravenous lignocaine on coughing and hemodynamics during extubation in neurosurgical patients: a randomized controlled double-blind trial. J Neurosurg Anesthesiol. 2006;18(4):230-4.