e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2024; 14(11); 218-221

Original Research Article

An Observational Study to Compare the Efficacy of Intravenous Esmolol for Attenuation of Pressor Response during Laryngoscopy and Endotracheal Intubation

Jayant Kumar Singh[1], Rajnish Briganja[2], Narendra Kumar[3]

[1]Senior Resident, Department of Anesthesiology, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India

[2]Senior Resident, Department of Anesthesiology, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India

[3]Associate Professor, Department of Anesthesiology, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India

Received: 16-09-2024 / Revised: 15-10-2024 / Accepted: 18-11-2024
Corresponding Author: Dr. Rajnish Briganja
Conflict of interest: Nil

Abstract

Background: Laryngoscopy as well as d endotracheal intubation are standard measures during anesthesia but are frequently linked to significant cardiovascular outcomes like as elevated heart rate (HR) and blood pressure (BP). Numerous pharmacological agents have been employed to mitigate these hemodynamic fluctuations. Esmolol, a short-acting β1-selective adrenergic blocker, has shown potential in minimizing the pressor effects associated with these procedures.

Objective: The objective of this study was to assess the effectiveness of intravenous esmolol in reducing the pressor response during laryngoscopy and endotracheal intubation in patients scheduled for elective surgeries.

Methods: This prospective observational study was conducted at SKMCH, Muzaffarpur, over a one-year period. The study included 100 patients aged 18 to 60 years undergoing elective surgeries. The primary goal was to compare the effectiveness of intravenous esmolol in attenuating the hemodynamic response during laryngoscopy and intubation. Heart rate and blood pressure were continuously monitored before and after intubation. Data analysis was performed using SPSS version 21.0, with statistical significance evaluated through t-tests and chi-square tests.

Results: Intravenous esmolol significantly decreased both heart rate and blood pressure in patients during and after laryngoscopy and intubation, as compared to the control group. At 1, 3, and 5 minutes post-intubation, patients in Group A (esmolol) exhibited notably lower heart rates and systolic/diastolic blood pressures ($p < 0.05$). There were no significant changes in oxygen saturation, and no adverse effects attributed to esmolol were observed. These findings indicate that esmolol effectively blunts the pressor response during intubation.

Conclusion: Esmolol administered intravenously is an effective agent for reducing the pressor response during laryngoscopy and endotracheal intubation, enhancing hemodynamic stability in patients under general anesthesia. This may be particularly advantageous for individuals with elevated cardiovascular risk.

Recommendations: Routine use of esmolol in elective surgeries involving endotracheal intubation is recommended, especially for patients prone to cardiovascular complications. Further research comparing esmolol with other beta-blockers or exploring its combination with different pharmacological agents is suggested to optimize control of hemodynamic parameters during anesthesia.

Keywords: Esmolol, Hemodynamic Response, Laryngoscopy, Endotracheal Intubation, Cardiovascular Stability.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Laryngoscopy and endotracheal intubation are critical components of anesthesia practice but often provoke significant hemodynamic responses, including increases in heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP). These pressor responses are primarily due to sympathetic nervous system stimulation, caused by mechanical irritation of the airway [1,2]. While these responses are generally transient, they can present serious risks to patients with pre-existing cardiovascular conditions such as hypertension, ischemic heart disease, or cerebrovascular disorders [3].

Mitigating these hemodynamic changes is crucial for ensuring patient stability during surgery, particularly in high-risk populations. A variety of pharmacological agents have been utilized to attenuate the pressor response, including opioids, vasodilators, and beta-blockers. Among these, beta-blockers, especially esmolol, have demonstrated efficacy due to their rapid onset and short duration of action. Esmolol is a cardioselective beta1-adrenergic receptor antagonist that effectively reduces tachycardia and hypertension without exerting prolonged effects on cardiovascular function [4].

Esmolol's pharmacokinetic properties make it particularly suitable for perioperative use. It has an ultra-short half-life of approximately 9 minutes, a result of rapid hydrolysis by plasma esterases, which allows for precise dosage control and swift reversal of its effects [5,6]. This makes esmolol a favorable option for managing acute pressor responses during laryngoscopy and intubation. Although previous studies have confirmed its efficacy in attenuating these responses, ongoing research is exploring its broader use, including in elective surgeries [7].

Despite the encouraging outcomes from past studies, variability persists regarding optimal dosing regimens and timing of esmolol administration to achieve the best results. This study aims to evaluate the effectiveness of intravenous esmolol in mitigating the pressor response during laryngoscopy and endotracheal intubation in patients undergoing elective surgeries at SKMCH, Muzaffarpur. By examining its impact on key hemodynamic parameters, this research seeks to provide further evidence supporting the use of esmolol as a standard part of anesthetic management.

Methodology

Study Design: The purpose of this prospective observational study was to evaluate how well intravenous esmolol attenuated the pressor response during endotracheal intubation as well as laryngoscopy.

Study Setting: The research was conducted at Sri Krishna Medical College and Hospital (SKMCH), Muzaffarpur, over a period of one year from September 2023 to September 2024.

Participants: The study involved 100 patients undergoing elective surgeries requiring endotracheal intubation. The patients, who ranged in age from 18 to 60, were assigned to either ASA physical status I or II.

Inclusion and Exclusion Criteria: Inclusion criteria encompassed patients aged 18 to 60 years, classified as ASA I or II, who required endotracheal intubation for elective surgeries. Exclusion criteria included patients with cardiovascular disease, uncontrolled hypertension, reactive airway disease, or any contraindications to beta-blockers. Additionally, patients on medications affecting heart rate or blood pressure were excluded from the study.

Bias: Selection bias was minimized through consecutive sampling of all eligible patients who met the inclusion criteria. To reduce observer bias, the clinician recording the outcomes was blinded to the group assignments.

Variables: The primary variables evaluated were heart rate and blood pressure, while secondary variables included oxygen saturation and any adverse reactions to esmolol**.**

Data Collection: HR, systolic and diastolic blood pressure, and oxygen saturation were measured at baseline, right after laryngoscopy, and one, three, and five minutes after intubation.

Procedure: Patients were divided into two groups: the esmolol group, which received intravenous esmolol, and the control group, which received no intervention. Standard monitoring procedures were employed throughout the process. Esmolol was administered 2 minutes before intubation, and hemodynamic parameters were recorded at the specified time intervals.

Statistical Analysis: The data were analyzed using SPSS software version 21.0.

Results

A total of 100 patients were enrolled in the study and divided into two groups: Group A (n=50) received intravenous esmolol, and Group B (n=50) served as the control group, receiving no esmolol. Both groups were comparable in terms of demographic variables, including age, gender, and baseline hemodynamic parameters ($p > 0.05$).

Demographic and Baseline Characteristics: The mean age of the participants in Group A was 42.5 ± 9.8 years, and in Group B, it was 43.2 ± 10.1 years ($p = 0.78$). The baseline heart rate and blood pressure of both groups were also comparable with no significant differences ($p > 0.05$).

Variable	Group A (Esmolol)	Group B (Control)	p-value
Age (years)	42.5 ± 9.8	43.2 ± 10.1	0.78
Gender (Male/Female)	30/20	28/22	0.75
Baseline HR (bpm)	75.4 ± 6.7	76.1 ± 7.2	0.67
Baseline SBP (mmHg)	124.5 ± 8.5	125.2 ± 9.1	0.80
Baseline DBP (mmHg)	78.3 ± 6.2	77.9 ± 6.4	0.85

Hemodynamic Response After Intubation: Group A's mean heart rate (HR) was considerably lower than Group B's at one minute after intubation (84.6 ± 5.4 bpm vs. 102.3 ± 8.5 bpm, $p < 0.001$). Similarly, Group A had significantly reduced DBP and SBP . Group A's heart rate and blood pressure were significantly lower than Group B's by three minutes after intubation ($p < 0.01$ for all comparisons). Although Group A continued to maintain statistically significant lower values ($p < 0.05$), the groups' blood pressure and heart rate were closer by five minutes after intubation.

Time Interval	Group A (Esmolol)	Group B (Control)
HR (1 min) (bpm)	84.6 ± 5.4	102.3 ± 8.5
SBP (1 min) (mmHg)	138.2 ± 7.6	158.4 ± 10.1
DBP (1 min) (mmHg)	85.3 ± 6.2	94.5 ± 7.2
HR (3 min) (bpm)	82.1 ± 5.2	95.7 ± 7.8
SBP (3 min) (mmHg)	135.5 ± 7.2	147.6 ± 9.8
DBP (3 min) (mmHg)	83.2 ± 5.8	90.2 ± 6.9
HR (5 min) (bpm)	80.3 ± 5.0	88.7 ± 6.5
SBP (5 min) (mmHg)	132.4 ± 6.9	140.3 ± 8.1
DBP (5 min) (mmHg)	81.5 ± 5.5	87.6 ± 6.0

Oxygen Saturation and Adverse Events: At no time point did the two groups' oxygen saturation levels differ significantly ($p > 0.05$). Group A did not experience any significant esmolol-related side effects.

Time Interval	Group A (Esmolol)	Group B (Control)	p-value
SpO2 (1 min) (%)	98.9 ± 0.5	99.1 ± 0.6	0.31
SpO2 (3 min) (%)	99.0 ± 0.4	99.2 ± 0.5	0.29
SpO2 (5 min) (%)	99.0 ± 0.3	99.1 ± 0.4	0.32
Adverse Events	None	None	N/A

Discussion

According to the study's findings, intravenous esmolol was very successful in reducing the pressor response during intubation and laryngoscopy. Patients in Group A (the esmolol group) had noticeably lower blood pressure and heart rates than those in the control group at all time points (1, 3, and 5 minutes post-intubation). Although esmolol maintained to maintain lower values than the control group, the attenuation effect peaked one minute after intubation and then gradually returned to baseline values by the five-minute mark.

No negative events were reported, and there were no discernible variations in oxygen saturation between the two groups. According to these results, esmolol can reduce the pressor response during laryngoscopy and intubation without impairing oxygenation or producing any significant adverse effects.

In a study published in 2021, Muralidharan and Murthy examined how well lignocaine and esmolol worked to lower the pressor response during these procedures. Their results showed that at 1, 3, and 5 minutes after intubation, esmolol was superior to lignocaine in reducing rises in BP and heart rate HR. In particular, when compared to lignocaine, esmolol significantly decreased MAP, DBP and SBP [8].

An earlier study examined cardiovascular responses to laryngoscopy as well as intubation after administering different doses of lidocaine, showing that while lidocaine was effective in blunting the pressor response, it was less potent than esmolol in subsequent research, particularly in maintaining lower HR and BP [9].

A randomized study explored the effects of varying esmolol doses in reducing the hemodynamic stress response during laryngoscopy and intubation. The study found that higher doses of esmolol were most effective at significantly reducing HR, SBP, and DBP, with a faster return to baseline values compared to lower doses [10]. Similar to this, Singh et al. (2013) examined how well esmolol and lidocaine mitigated the cardiovascular stress response in a Ghanaian population during intubation. During the crucial post-intubation phase, esmolol outperformed lidocaine in preserving lower HR and blood pressure values [11].

Conclusion

This study offers compelling proof that intravenous esmolol successfully reduces the pressor response during endotracheal intubation and laryngoscopy. The use of esmolol in perioperative settings to prevent adverse cardiovascular events is supported by current literature, which is in line with our findings. The long-term effects of esmolol use in a variety of patient populations, especially those at

risk for cardiovascular disease, should be the main focus of future studies.

References

1. Sachidananda R, Umesh G. A review of hemodynamic response to the use of different types of laryngoscopes. Anaesthesia, Pain & Intensive Care. 2019 Jan 24:201-8.
2. Altun D, Ali A, Çamcı E, Özonur A, Seyhan TÖ. Haemodynamic response to four different laryngoscopes. Turkish journal of anaesthesiology and reanimation. 2018 Dec;46(6):434.
3. Severino P, D'Amato A, Pucci M, Infusino F, Adamo F, Birtolo LI, Netti L, Montefusco G, Chimenti C, Lavalle C, Maestrini V. Ischemic heart disease pathophysiology paradigms overview: from plaque activation to microvascular dysfunction. International journal of molecular sciences. 2020 Oct 30;21(21):8118.
4. Alappat AM. Evaluation of Haemodynamic Stability Following Induction of General Anaesthesia with Propofol and Etomidate in Normotensive and Hypertensive Patients: A Comparative Study (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
5. Gilani SO, Li R, Ortiz J. Esmolol as a Perioperative Opioid-Sparing Adjunct: Review of the Literature. Topics in Pain Management. 2020 Jun 1;35(11):1-9.
6. Hanna FJ. An Anesthesia-Based Quality Improvement Initiative to Decrease Opioid Administration via Esmolol Administration (Master's thesis, West Virginia University).
7. Burgdorff AM, Feudlinske AK, Förster A, Werdan K, Unverzagt S. Blood pressure, heart rate, and arrhythmia control in the perioperative setting by the short-acting betablocker esmolol: A review. American Research Journal of Anesthesia. 2018;2(1):1-28.
8. Muralidharan V, Murthy KS. Comparing the efficacy of esmolol and lignocaine for attenuating the pressor response during laryngoscopy and endotracheal intubation. Int J Health Sci Res. 2021;11(3):226-232.
9. Abou-Madi MN, Keszler H, Yacoub JM. Cardiovascular reactions to laryngoscopy and tracheal intubation following small and large intravenous doses of lidocaine. Can Anaesth Soc J. 1977; 24:12-9.
10. Vucovic M, Ebert TJ, Bernstein JS. A randomized study of esmolol to attenuate the hemodynamic stress response during laryngoscopy and endotracheal intubation. IOSR J Dent Med Sci. 2017;16(7):9-12.
11. Singh S, Laing EF, Owiredu WK, et al. Comparison of esmolol and lidocaine for attenuation of cardiovascular stress response to laryngoscopy and endotracheal intubation in a Ghanaian population. Anesth Essays Res. 2013;7 (1):83-88.