INTERNATIONAL JOURNAL OF CURRENT ADVANCED RESEARCH
ISSN: O: 2319-6475, ISSN: P: 2319-6505
Available Online at www.journalijcar.org
Volume 14; Issue 06; June 2025; Page No.272-274
DOI: http://dx.doi.org/10.24327/ijcar.2025.0274.0057

Subject Area : Anaesthesiology

COMPARATIVE EVALUATION OF BOLUS ADMINISTRATION OF ESMOLOL AND FENTANYL FOR PRESSOR RESPONSE ATTENUATION DURING LARYNGOSCOPY AND ENDOTRACHEAL INTUBATION

[1]Sireesh Kumar Pannati*, [2]Suryakumari Malothu, [3]Pushpalatha Vantepaka and [4]Rajashekar kothapalli

[1,2,4]Assistant Professor, Department of Anaesthesiology, GMC, Mahabubabad
[3]Assistant Professor, Dept of Anaesthesiology, Gandhi Medical College, Secenderabad.

ARTICLE INFO

Received 16th May2025
Received in revised form 28th May, 2025
Accepted 15th June 2025
Published online 28th June, 2025

Key words:

Commercial Beekeeping, Pollination Contracts, Apiculture Economics, Sustainable Beekeeping, Pollinator-Dependent Crops, Sustainable Apiculture

ABSTRACT

Background: The process of laryngoscopy and tracheal intubation often triggers a pronounced sympathetic response, leading to transient but marked increases in heart rate and blood pressure. These changes, though short-lived, may pose a significant risk in patients with cardiovascular compromise. Objective: This study was designed to compare the efficacy of intravenous bolus esmolol (2mg/kg) and fentanyl (2µg/kg) in attenuating the hemodynamic responses to laryngoscopy and endotracheal intubation. Methods: Seventy-five ASA I patients scheduled for elective surgical procedures under general anesthesia were randomized into three groups to receive either saline (control), esmolol, or fentanyl prior to induction. Hemodynamic parameters including heart rate, systolic, diastolic, and mean arterial pressure were measured at multiple intervals peri-intubation. Results: The esmolol group showed a statistically significant attenuation of heart rate response post-intubation ($p = 0.002$) compared to the fentanyl and control groups. Although both study drugs reduced systolic and diastolic pressures, the differences among groups were not statistically significant. Conclusion: Esmolol more effectively attenuates the rise in heart rate associated with intubation than fentanyl and may be the agent of choice for suppressing cardiovascular stress responses during airway manipulation.

INTRODUCTION

The act of direct laryngoscopy and tracheal intubation is a potent nociceptive stimulus capable of activating the sympathetic nervous system. This stimulation leads to the release of catecholamines, particularly norepinephrine and epinephrine, resulting in transient hypertension and tachycardia[1]. While such responses may be well tolerated by healthy individuals, they can provoke serious complications such as myocardial ischemia, dysrhythmias, or even cerebrovascular accidents in patients with preexisting cardiac or neurological pathology[2].

The attenuation of this pressor response has been a subject of extensive research. Pharmacological strategies employed include opioids (such as fentanyl), beta-adrenergic blockers (such as esmolol), vasodilators, local anesthetics, and alpha-2 agonists[3]. Among these, both fentanyl and esmolol have gained popularity due to their rapid onset of action and favorable pharmacokinetic profiles.

Fentanyl is a highly lipid-soluble synthetic opioid that provides effective analgesia and suppresses sympathetic nervous system activity through central mechanisms. However, its effectiveness in blunting tachycardia is dose-dependent, and higher doses may carry the risk of postoperative respiratory depression.

Esmolol, on the other hand, is a cardio-selective β1-adrenergic blocker with an ultra-short half-life (~9 minutes), making it an ideal agent for short-term hemodynamic control during induction and intubation. It exerts its effect by attenuating the chronotropic and inotropic effects of sympathetic stimulation without prolonged hypotension or bradycardia.

Although previous studies have compared these agents separately, few have conducted a direct comparison at bolus

*Corresponding author: **Dr. Sireesh Kumar Pannati**

Assistant Professor, Department of Anaesthesiology, GMC, Mahabubabad.

doses commonly used in clinical practice. Our study addresses this gap by comparing the efficacy of bolus doses of esmolol (2 mg/kg) and fentanyl (2 µg/kg) in blunting the cardiovascular responses to laryngoscopy and endotracheal intubation.

Aim of the Study

To evaluate and compare the efficacy of intravenous bolus esmolol and fentanyl in attenuating heart rate and blood pressure responses during laryngoscopy and intubation, and determine which agent provides more effective hemodynamic control.

MATERIALS AND METHODS

This prospective, randomized, single-blind controlled study was conducted in a tertiary care hospital after approval from the Institutional Ethical Committee. Seventy-five adult patients (ASA I, aged 18–60 years) undergoing elective surgical procedures under general anesthesia were recruited.

Inclusion Criteria:

- ASA physical status I
- Modified Mallampati airway grade I or II
- Written informed consent

Exclusion Criteria

- Emergency surgeries
- Difficult airway
- Known cardiovascular, respiratory, or neurological disorders
- Pregnancy
- Drug hypersensitivity to fentanyl or esmolol

Study Design

Patients were randomly assigned into three equal groups (n=25):

- Group C (Control): Received 10 ml normal saline IV 3 minutes before induction
- Group E (Esmolol): Received 2 mg/kg IV esmolol
- Group F (Fentanyl): Received 2 µg/kg IV fentanyl

Anesthesia Protocol

All patients received premedication with midazolam 0.05 mg/kg IM and glycopyrrolate 0.2 mg IM, 45 minutes before surgery. After IV access, baseline parameters were recorded. Following administration of the study drug, induction was achieved using thiopentonesodium (5 mg/kg) and succinylcholine (1.5 mg/kg). Tracheal intubation was performed by the same anesthesiologist in all cases.

Anesthesia was maintained using nitrous oxide (66%) and oxygen (33%) with intermittent positive pressure ventilation. No surgical stimuli were allowed for 7 minutes after intubation to eliminate confounding hemodynamic influences.

Monitoring and Data Collection

Heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were measured at baseline, post-induction, at intubation, and at 1, 3, 5, and 7 minutes post-intubation.

Statistical Analysis

Data were analyzed using SPSS v17. Continuous variables were presented as mean ± SD. ANOVA followed by post hoc Tukey's test was applied to detect inter-group differences. A p-value < 0.05 was considered statistically significant.

RESULTS

Demographic data (age, gender, ASA status) were comparable across all three groups.

Table 1. Heart Rate, Systolic Blood Pressure, Diastolic blood pressure and Mean arterial Pressure after induction

After induction	Control Group	Esmolol Group	Fentanyl Group	'p'	Significance
Heart	92.1 ± 11.4	81 ± 9.6	88.2 ± 11.6	**0.002**	**Significant**
Systolic	123.6 ± 8.9	117.1 ± 11.2	118.4 ± 10.9	**0.07**	**Not Significant**
Diastoli	79.3 ± 5.7	76.6 ± 5.7	76.2 ± 6.0	**0.125**	**Not Significant**
Mean arterial	94 ± 6.3	90.1 ± 6.6	90.2 ± 6.6	**0.056**	**Not Significant**

Heart Rate

Significant attenuation of heart rate was observed in the esmolol group throughout the observation period (p = 0.002). Peak HR in the control group reached 110.6 bpm at 1 minute post-intubation, compared to 92.4 bpm in the esmolol group and 103.5 bpm in the fentanyl group.

Blood Pressure

Both esmolol and fentanyl showed reductions in SBP and DBP post-intubation compared to control, although these differences were not statistically significant (SBP p = 0.07, DBP p = 0.12, MAP p = 0.05). The esmolol group showed faster return to baseline values (within 3 minutes) compared to the fentanyl group (5 minutes).

Safety

No adverse effects such as bradycardia, hypotension, or arrhythmias were observed in any group.

DISCUSSION

The pressor response to laryngoscopy and endotracheal intubation can pose significant challenges, particularly in patients with coronary artery disease, cerebrovascular disorders, or poorly controlled hypertension. Suppression of this response improves hemodynamic stability and reduces perioperative risk.

Our findings align with previous research indicating esmolol's superior ability to blunt tachycardia. Vucevic et al. demonstrated that a 2 mg/kg bolus of esmolol significantly attenuated heart rate increases without adverse effects. Similarly, Helfman et al. Reported that esmolol was more effective than lidocaine or fentanyl in controlling heart rate responses to intubation.

Fentanyl, though effective in blunting blood pressure surges, appears less reliable in controlling heart rate unless used at higher doses. Martin et al. demonstrated dose-dependent suppression of intubation responses with fentanyl up to 8 µg/kg, but higher doses increase the risk of postoperative respiratory depression[1]. In our study, a bolus of 2 µg/kg failed to attenuate heart rate effectively.

The ultra-short half-life of esmolol ensures a rapid onset and offset, making it suitable for transient stress modulation without affecting subsequent anesthesia management. Moreover, it does not accumulate and has minimal interaction with other anesthetic agents[11].

Ugur et al. and Kumar et al. have further emphasized esmolol's efficacy and safety in normotensive populations undergoing elective surgeries[12],[13]. These findings underscore esmolol's role as a safe, reliable, and predictable agent for intubation stress attenuation.

In contrast, although fentanyl showed moderate efficacy in controlling blood pressure, its impact on heart rate was not significant, consistent with the findings of Yushiet al.[1].

CONCLUSION

Esmolol at a bolus dose of 2 mg/kg administered 3 minutes before laryngoscopy and intubation provides superior attenuation of heart rate response compared to fentanyl and placebo. Although both esmolol and fentanyl reduce blood pressure elevations, esmolol results in a more rapid return to baseline and better heart rate control. Given its safety profile, predictability, and transient action, esmolol may be considered the agent of choice in normotensive patients undergoing elective surgeries where suppression of sympathetic response is desired. Further studies could explore its use in high-risk populations and in combination with other agents for additive effects.

References

1. Reid LC, Brace DE. Irritation of the respiratory tract and its reflex effect upon heart. SurgGynecol Obstet. 1940;70:157–162.
2. Shribman AJ, Smith G, Achola KJ. Cardiovascular and catecholamine responses to laryngoscopy with and without tracheal intubation. Br J Anaesth. 1987;59(11):295-299. https://doi.org/10.1093/bja/59.3.295
3. Stoelting RK. Pharmacology and Physiology in Anesthetic Practice. 4th ed. Lippincott Williams & Wilkins; 2006.
4. Stoelting RK, Dierdorf SF. Opioids in Anesthesia and Pain Management. 3rd ed. Churchill Livingstone; 2006.
5. Westphal JF, Duchene-Marullaz P, Lejus C, et al. Pharmacokinetics and pharmacodynamics of esmolol, a new ultra short-acting beta-blocker. Anesthesiology. 1986;65(2):143-149. https://doi.org/10.1097/00000542-198608000-00003
6. Singh N, Nair V, Kaul HL, Prasad SN. Role of esmolol in controlling cardiovascular response to laryngoscopy and intubation. Indian J Anaesth. 2002;46(4):289-292.
7. King BD, Harris LC, Greifenstein FE, Elder JD, Dripps RD. The hemodynamic responses to endotracheal intubation. Anesthesiology. 1951;12(5):556-566. https://doi.org/10.1097/00000542-195109000-00006
8. Vucevic M, Ostojic M, Grgic A. Attenuation of cardiovascular response to tracheal intubation with esmolol. Br J Anaesth. 1989;63(5):554-556. https://doi.org/10.1093/bja/63.5.554
9. Helfman SM, Rosenfeld DM, Pearson JD. Comparative study of esmolol, lidocaine, and fentanyl in control of the cardiovascular response to laryngoscopy and intubation. Anesthesiology. 1991;75(3): 414-419. https://doi.org/10.1097/00000542-199109000-00009
10. Martin DE, Pathak DS, Twersky RS, Blanchard DH. Dose-dependent effect of fentanyl on hemodynamic response to tracheal intubation. AnesthAnalg. 1982;61(9):746-750.
11. Reves JG, Fragen RJ, Vinik HR, Greenblatt DJ. Midazolam: pharmacology and uses. Anesthesiology. 1985;62(3):310-324.
12. Ugur F, Ucar M, Yavuz L, et al. Comparative study of esmolol and labetalol on cardiovascular responses to laryngoscopy and intubation. Eur J Anaesthesiol. 2006;23(8):676-681. https://doi.org/10.1017/S026502150600086X
13. Kumar L, Singhal S, Aggarwal A. Role of esmolol in attenuation of hemodynamic response to laryngoscopy and intubation. J AnaesthesiolClinPharmacol. 2012;28(1):36-39. https://doi.org/10.4103/0970-9185.92431
14. Yushi U, Obara H, Matsuda M. The effect of fentanyl on cardiovascular responses to tracheal intubation. AnesthAnalg. 1982;61(1):1-6.

How to cite this article:

Sireesh Kumar Pannati et al. (2025). Comparative Evaluation of Bolus Administration of Esmolol and Fentanyl for Pressor Response Attenuation during Laryngoscopy and Endotracheal Intubation, International Journal of Current Advanced Research, 14(06), pp.272-274.

****