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Comparing Esmolol and Lidocaine for Reducing Cardiovascular Stress Response during Laryngoscopy and Endotracheal Intubation

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Abstract: Direct laryngoscopy and endotracheal intubation often trigger a cardiovascular stress reaction due to reflex sympathetic stimulation. This response can pose risks to patients with conditions like hypertension, coronary artery disease, myocardial disease, or cerebrovascular disease. To address this concern, various medications have been explored to mitigate this stress response. This study was conducted in light of the aforementioned considerations to assess the comparative effectiveness of intravenous esmolol and lignocaine in suppressing the cardiovascular stress response. Patients were divided into three groups, each consisting of 10 individuals. Group-C received no medication under investigation. Group-L received lignocaine, while Group-E received esmolol three minutes before intubation. All groups were monitored for changes in hemodynamic parameters, such as heart rate (HR) and systolic and diastolic blood pressure, every minute from intubation up to 5 minutes afterward. The results indicated that patients administered esmolol exhibited superior attenuation of the stress response to laryngoscopy and intubation compared to those given lignocaine.

INTRODUCTION

Direct laryngoscopy and endotracheal intubation often elicit a cardiovascular stress response, marked by a temporary increase in blood pressure and heart rate due to reflex sym- pathetic activation. This response typically begins around 30 seconds after intubation and subsides within 8 minutes [1]. While this response might be well tolerated by individuals in good health, it can pose significant risks to patients with conditions such as hypertension, coronary artery disease, cerebrovascular disease, myocardial infarction, and thyrotox- icosis [2]. Various medications, including opioids, calcium channel blockers, beta-blockers, magnesium sulfate, and lo- cal anesthetics, have been employed to mitigate this stress response [3]–[5]. Several research studies have investigated the effectiveness of intravenous lignocaine in reducing the hemodynamic response to laryngoscopy and intubation [6], [7]. Notably, Abou-Madi et al. [8] identified that intravenous lignocaine at a dose of 1.5 mg/kg administered three minutes before laryngoscopy was the optimal dosage for attenuating this response. However, it's worth noting that Miller et al.
[9] did not find any significant benefit of administering intravenous lignocaine at a dose of 1.5 mg/kg, regardless of whether it was given 1, 2, or 3 minutes before laryn- goscopy. Among the various blockers, esmolol stands out as an attractive option due to its cardioselectivity and ultra-short duration of action, lasting only 9 minutes [10]. Therefore, the present study was conducted to compare the effectiveness of intravenous esmolol and lignocaine in mitigating the stress response associated with laryngoscopy and endotracheal in-tubation.

I. MATERIALS AND METHODS

The study encompassed 30 patients, both male and female, classified as ASA Grade I & II, within the age range of 18 to 40 years. These patients were selected for elective non-cardiac surgical procedures. Exclusion Criteria: Patients meeting any of the following criteria were excluded from the study:

- Heart rate below 80 beats per minute.
- Basal systolic blood pressure lower than 100 mm

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Hg.

- A history of asthma.
- Any cardiac disease.
- Presence of heart block.

Preanesthetic Preparation: Patients underwent overnight half an hour before the surgical procedure. Random Alloca- tion: Patients were randomly assigned to one of three groups, each consisting of 10 individuals. This allocation was done using permuted block randomization. Group-C: Patients in this group did not receive any of the study drugs. Group- L: Patients in this group were given preservative-free intra- venous lignocaine (at a dose of 1.5 mg/kg of a 2% solution) three minutes before intubation. Group-E: Patients in this group received intravenous esmolol (at a dose of 1.5 mg/kg of a 1% solution) three minutes before intubation. Anesthetic Technique: Upon placement on the operating table, an intra- venous line was established, and monitors for ECG, NIBP (non-invasive blood pressure), and SPO2 (oxygen saturation) were fast-ing and were provided with sedation in the form of a 0.25 mgoral dose of alprazolam at bedtime. On the day of surgery, 0.2 mg of intramuscular glycopyrrolate and 1 mg per kilogram of body weight of intramuscular tramadol were administered attached. Baseline measurements were recorded for key parameters, including heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP), before the ad- ministration of any drugs. After a 3-minute preoxygenation period, calculated doses of lignocaine and esmolol were slowly administered intravenously to patients in groups L and E, respectively. One minute after receiving lignocaine or esmolol, patients were induced with an intravenous injection of thiopentone sodium at a dose of 5 mg/kg. This was fol- lowed by the administration of intravenous succinylcholine at a dose of 1.5 mg/kg to facilitate intubation. The total duration of laryngoscopy was recorded, and patients whose

Demographic & Haemodynamic Characteristics(Mean±SD)	Group C (n =10)	Group E (n = 10)	Group L (n = 10)
Age (yrs.)	30.4 ± 7.1	31.8 ± 6.6	31.55 ± 5.3
Weight (Kg)	52.9 ± 7.2	53.2 ± 8.5	55.5 ± 5.1
Male: Female*	1:3	1:3	1:2.3
HR/ minute	80.07 ± 6.05	78.45 ± 5.77	78.35 ± 6.10
MAP mm Hg	93.9 ± 5.9	94.5 ± 5.1	94.7 ± 6.2
Systolic BP mm Hg	125.05 ±7.8	125.4 ± 7.4	126.75 ± 8.9
Diastolic BP mm Hg	78.35 ± 4.9	77.85 ± 5.5	78.75 ±5.9

TABLE 1: Demographic and Baseline Haemodynamic Char-acteristics

Time	Group C Mean ± SD	Group E Mean ± SD	Group L Mean ± SD	Statistical * Inference
0 Minute	120 ± 9.48	96.45 ± 6.6	116. ± 6.70	F 59.04 p =.001 H.S
1 Minute	110.65 ± 12.74	94.2 ± 4.7	104 ± 8.1	F 16.27 p =.000 H.S

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2Minutes	101.4 ± 13.9	92.1 ± 4.4	97.95 ± 7.8	F 4.60 p = .014 Significant (S)

TABLE 2: Changes in Heart rate (HR) at Varying Time Interval After Intubation

minutes after intubation. Likewise, after intubation, there was a highly significant (P<0.001) attenuation of diastolic bloodpressure in Group-E when compared to the other groups, and this attenuation remained significant until 2 minutes after intubation. However, in laryngoscopy duration exceeded 30 seconds were excluded from the study. Anesthesia was maintained using a com- bination of oxygen (O2), nitrous oxide (N2O), halothane, and intravenous injection of pancuronium. At the conclusion of the surgical procedure, patients were reversed using an intravenous injection of neostigmine at a dose of 0.05 mg/kg and glycopyrrolate at a dose of 0.01 mg/kg, followed by extubation. Throughout the procedure, key parameters such as heart rate, systolic blood pressure, and diastolic blood pressure were monitored at one-minute intervals for up to 5 minutes after intubation, and then at 5-minute intervals thereafter.

III. RESULTS

All three groups exhibited similar demographic profiles and baseline values for blood pressure and heart rate. How- ever, immediately after intubation and beyond, there was a statistically insignificant (p>0.05) increase in heart rate in Group-C when compared to Group-L. Still, the difference became statistically significant when compared to Group- E, and this significant difference persisted until 2 minutes after intubation. When comparing Group-L and Group-E, there was a more pronounced attenuation of the heart rate response in Group-E, and this difference was significant until 1 minute after intubation. Following intubation, there was a statistically significant attenuation in the increase in systolic blood pressure in Group-E when compared to Group- C, and this significant difference persisted until 1 minute after intubation. In contrast, Group-L exhibited a statistically significant increase in systolic blood pressure compared to Group-E, and this difference remained significant until 2 The specific mechanism that underlies the hemodynamic response to Group-L, the attenuation of diastolic blood pressure was statistically insignificant when comparedto Group-C.

IV. DISCCUSSION

laryngoscopy and intubation likely stems from intense sympathetic activity triggered by the stimulation of the epipharynx and laryngopharynx [1]. Hassan [11] has further suggested that during laryngoscopy and endotracheal intubation, the insertion of the tube through the vocal cords and the inflation of the cuff in the infraglottic region play a significant role in augmenting the sympathoadrenal response initiated by supraglottic stimulation. It's worth noting that age might be a crucial factor influencing the cardiovascular response to tracheal intubation. Ismail [12] noted a more pronounced increase in systolic blood pressure following laryngoscopy and intubation in elderly and middle-aged pa- tients compared to young individuals. This difference could be attributed to variations in the balance between sympathetic and parasympathetic nervous system activity or heightened sensitivity of receptors. To mitigate this hemodynamic re- sponse, various drugs and techniques have been employed. Blocking drugs are one approach used to reduce the elevation in heart rate and blood pressure by dampening the positive chronotropic and ionotropic effects resulting from increased adrenergic activity. Esmolol possesses several advantageous properties that make it a valuable agent for mitigating the cardiovascular response. Firstly, it is a cardioselective agent, meaning it primarily affects the heart without significant im-pact on other organs. Secondly, it has an ultra-short duration of action, lasting only 9 minutes. Thirdly, there have been no significant reports of drug interactions with commonly used anesthetics [13]. However, consensus has yet to be reached regarding the optimal dose and timing of its administration [14]. In our study, we observed that the increase in heart

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rate in patients receiving esmolol was significantly attenuated when compared to the other two groups ($p < 0.001$), and this attenuation persisted for a maximum duration of 2 minutes after intubation. It's important to note that there was a sta- tistically significant increase in heart rate in all three groups ($p < 0.05$) when compared to baseline levels, underscoring the commonality of this cardiovascular response to intuba- tion. The findings in our study align with those reported by Korpinen et al. [15] and Shroff et al. [16], suggesting that es- molol is effective in attenuating the cardiovascular response to intubation. Lignocaine has also been a popular choice for mitigating the circulatory responses associated with in- tubation. It is valued for its properties, including analgesic effects, antiarrhythmic properties, rapid onset, short duration of action, and the ability to suppress laryngeal reflexes, as noted by Badrinath et al. [17]. However, our study yielded different results, showing that patients in Group-L exhib- ited less attenuation of hemodynamic variables compared to Group-E and statistically insignificant attenuation compared to Group-C. This discrepancy suggests that, in the context of your study, esmolol may be more effective in blunting the cardiovascular response to intubation than lignocaine.

V. CONCLUSION

Intravenous lignocaine at a dose of 1.5 mg/kg administered 3 minutes before intubation was found to be relatively in- effective in attenuating the hemodynamic response to laryn-goscopy and intubation in your study. In contrast, esmolol administered at the same dose of 1.5 mg/kg as a bolus was more effective in blunting this response without any adverse effects. These findings suggest that esmolol may be a more suitable option for mitigating the cardiovascular stress response associated with laryngoscopy and intubation, as it appears to offer better outcomes compared to lignocaine in your study.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

ETHICAL CONSIDERATION

Compliance with ethical guidelines Ethical approval for thisstudy was obtained from the University of Baghdad Faculty of nursing Institutional Research Board (Code:25/11/2021- 2105).

AUTHORS' CONTRIBUTIONS

All authors equally contributed to preparing this article.

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