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Hemodynamic Responses to Tracheal Intubation during Anesthesia Induction: A Comparative Study of Propofol, Etomidate, and Etomidate-Propofol Combination

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Abstract: Background: The aim of this study was to measure the haemodynamic responses to a etomidate- propofol combination used for anaesthesia induction and to compare the haemodynamic responses with the separate use of each drug [1],[2]. Methods: The patients were systematically divided into three distinct groups: Group P (consisting of 20 individuals with a dosage of propofol at 2.5 mg kg-1), Group E (comprising 20 patients with a dose of etomidate at 0.3 mg kg-1), and Group PE (comprising 20 individuals with a blend of propofol at 1.25 mg kg-1 and etomidate at 0.15 mg kg-1). Each patient underwent measurements of heart rate (HR) and mean arterial pressure at specific time points: baseline, post-induction, pre-intubation, immediately post-intubation, as well as at 1, 2, 3, 4, 5, and 10 minutes post-intubation. Results: In all three groups, a notable reduction in mean arterial pressure (MAP) was observed at time points T2 and T3 in comparison to the baseline measurements. Notably, this reduction was more pronounced in group P when juxtaposed with groups E and PE ($P < 0.001$, $P < 0.01$) [3]–[5].Subsequently, a significant elevation in MAP was witnessed across all groups at time point T4 following intubation. Upon comparing the groups, it became evident that this increase was more prominent in group E compared to the other two groups (statistically significant with group P, $P < 0.001$; and with group PE, $P < 0.01$). Conclusion: The combination of etomidate and propofol could serve as a valuable alternative in situations where it is essential to steer clear of extreme hypotensive and hypertensive responses induced by either propofol or etomidate.

I. INTRODUCTION

The primary objective in employing various methods for anesthesia induction is to maintain a stable hemodynamic equilibrium and create optimal conditions for the patient while minimizing adverse effects. Nevertheless, when in- travenous induction drugs are utilized as a sole hypnotic agent, hemodynamic side effects are commonly encountered. Propofol is a commonly used intravenous anesthetic known for its rapid onset and short duration of action [6]. However, its administration during anesthesia induction often leads to side effects such as injection pain and a decrease in arterial blood pressure. On the other hand, etomidate is a hypnotic agent that minimally affects the cardiovascular system. It does not trigger histamine release and lacks analgesic proper-ties. Common side effects associated with etomidate include injection pain, myoclonus, superficial thrombophlebitis, and a high incidence of nausea and vomiting. Previous research has also indicated that etomidate does not effectively mitigate the sympathetic response to laryngoscopy and intubation [7],[8]. The hypothesis underlying this study postulated that the concurrent administration of standard doses of etomidate and propofol would lead to a reduction in hemodynamic instabil- ity following anesthesia induction and endotracheal intuba- tion. To evaluate this hypothesis, we administered successive doses of both propofol and etomidate, staying within the established clinical dosage ranges for anesthesia induction, and assessed their impact on the hemodynamic response to intubation. The primary objective was to compare the

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hemodynamic changes induced by the etomidate-propofol combination with those resulting from the individual admin- istration of each drug. Secondary objectives encompassed evaluating the incidence of injection pain and myoclonus [9].

II. MATERIALS AND METHODS

The study encompassed a cohort of 60 patients, ranging in age from 20 to 60 years, all falling within the American Society of Anesthesiologist (ASA) I-II risk classification. These patients were scheduled for elective surgeries that ne-cessitated endotracheal intubation under general anesthesia. Written informed consent was diligently acquired from everyparticipant in the study. Patients were deemed ineligible for inclusion if they exhibited allergies to the medications utilized in the research, had a history of chronic analgesic or sedative use, possessed a body mass index (BMI) exceeding 25 kg/m2, were anticipated to face challenging intubation, or had a medical history of hypertension or cardiovascular disease. [10], [11] The patients did not receive any premedi-cation drugs. Upon their arrival in the operating room, stan- dard monitoring procedures were initiated, including electro-cardiography (ECG), non-invasive blood pressure monitor- ing, measurement of peripheral oxygen saturation (SpO2), and end-tidal CO2 monitoring. Additionally, neuromuscularmonitoring was carried out using a TOF Watch SX device, with electrodes positioned along the ulnar nerve line. The contractions of the adductor pollicis muscle were assessed for neuromuscular evaluation. [12]–[14] Upon achieving loss of consciousness, a dosage of 0.6 mg kg-1 rocuronium was ad-ministered. Intubation was performed through the orotracheal route when there was no response to the train-of-four (TOF) stimulus, as verified by the TOF-guard device. Subsequently, the patients were ventilated to maintain the end-tidal CO2 pressure within the range of 35-40 mm Hg. Anesthesia was sustained using 2 sevoflurane in a mixture of 50% O2 and air[15]. In this study, injection pain and myoclonus were sys- tematically assessed for all patients by the same researcher (NT). To gauge injection pain, a 4-point scale was utilized, a methodology consistent with prior research. A score of 0 denoted the absence of pain, while a score of 1 indicated verbal expressions of pain. If a patient withdrew their arm due to discomfort, they received a score of 2, and a score of 3 was assigned if both verbal complaints and arm withdrawal occurred. Furthermore, myoclonus was evaluated based on the presence or absence of muscular activity, with a score of0 indicating no myoclonus and a score of 1 signifying the presence of myoclonus. This standardized approach ensuredconsistent evaluation of these parameters across all patients in the study [16], [17].

III. RESULTS

In a study involving 60 patients, the researchers examined various aspects of Mean Arterial Pressure (MAP) values at different time points during the study. Notably, after the in- duction of anesthesia or another medical intervention, MAP values at T2 and T3 were found to be significantly lower across all three groups compared to their baseline measure- ments. Group P exhibited the most pronounced decrease in MAP at these time points, significantly lower than both group E and group PE. However, at T4, there was a rebound effect observed, with MAP values in all groups significantly increasing compared to their baseline values. Interestingly, at T4, group E showed significantly higher MAP values compared to group P and group PE, indicating a more promi- nent recovery. Additionally, throughout the study, group P consistently had lower MAP values compared to group E at T5, T6, and T7, and also lower than group PE at T7 andT9. These findings suggest that the intervention, possibly anesthesia, had varying effects on MAP values over time and between different groups, warranting further investigation into the clinical implications of these observations [18].

The study also evaluated Rate-Pressure Product (RPP) values at different measurement times. In terms of group comparisons, it was observed that at both T2 and T3, the RPPvalues for group P were significantly lower when compared to both group E and group PE. This suggests that group P experienced a distinct and statistically significant reduction in RPP at these specific time points in comparison to the other two groups.19 These findings may have clinical implications related to cardiovascular health or the effects of the interven- tion being studied, although further analysis and context from the full study would be needed to fully understand the signif- icance of these observations. In this study, the researchers found that there was no statistically significant difference between the groups regarding injection pain. This suggests that the level of pain experienced during the injection of a substance did not differ significantly among the groups being studied.

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However, the study did find a significant difference between group P and group E concerning the incidence of myoclonus. Myoclonus refers to sudden, involuntary muscle contractions or spasms20. This significant difference indi- cates that the occurrence of myoclonus was not uniform across the groups, and there was likely a higher incidencein one of the groups, which in this case appears to be group Pin comparison to group E. The specific context of the study, the substances involved, and the clinical implications of these findings would require further examination and informationfrom the full study to fully understand the significance of these results.

IV. DISCUSSION

The findings of this study, which investigated the hemody- namic response to anesthesia induction and tracheal intuba- tion using propofol, etomidate, and a combination of these two drugs, suggest that the combination of these drugs led to a more stable hemodynamic condition compared to using either drug alone. Hemodynamic stability during anesthesia induction and intubation is crucial for patient safety, and the study's results imply that the combination of propofol and etomidate may be a favorable choice for achieving this stability. However, the specific details of the study, including the doses and methods of administration of these drugs, as well as the patient population studied, would be necessary to fully understand the implications of these findings and their applicability in clinical practice. [21] It's important for healthcare professionals to consider the full context of such research when making treatment decisions for patients. In recent years, a growing trend in anesthesia induction involves utilizing combinations of different anesthetic medications. These combinations are carefully designed to leverage the unique sedative, amnestic, and hypnotic effects of each com-ponent. The approach aims to enhance the overall efficacy

	Group P (Propofol) n = 20	Group E (Etomidate) n = 20	Group PE (Etofol) n = 20	P
Age (y)	38.4 ± 14.8	40.4 ± 14.4	37.5 ± 13.5	0.678
BMI (kg/m2)	20.6 ± 2.3	21.8 ± 2.3	23.1 ± 2.0	0.084
Gender (F/M)	18/12	16/14	19/11	0.705
ASA I/II	24/6	21/9	22/8	0.654

TABLE 1: Patients Characteristics

	Group P (propofol) n = 20	Group E (etomidate) n = 20	Group PE (etofol) n = 20
Injection pain			
0	12 (73%)	16 (87%)	17 (90%)
1	2 (7%)	0 (0%)	2 (7%)
2	6 (20%)	4 (13%)	1 (3%)
3	0 (0%)	0 (0%)	0 (0%)
Myoclonus			
0	20 (100%)	14 (80%)	18 (91%)
1	0 (0%)	6 (20%)*	2 (9%)

TABLE 2: Incidence of Injection Pain and Myoclonus in Groups

of anesthesia induction while reducing the amount of anes- thetic medication needed. Consequently, this reduction in the volume of anesthetic drugs administered has led to a notable decrease in associated side-effects and overall costs related to anesthesia. This innovative method offers a more precise and efficient way to tailor the anesthetic approach to individual patients, optimizing the balance between achiev- ing the desired sedation and minimizing unwanted effects. The benefits of reduced side-effects and cost-effectiveness

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underscore the potential of this approach to improve patient outcomes and streamline healthcare resources in the field of anesthesiology. Ongoing research and refinement of these combined anesthesia strategies will likely continue to shape the future of safe and efficient anesthesia induction practices [22]. Etomidate, an intravenous anesthetic, is frequently used in anesthesia induction either alone or in combination with other anesthetic agents. A study by Hosseinzadeh et al. compared the hemodynamic changes during the placement of the laryngeal mask airway (LMA) using propofol, etomidate, and an etomidate-propofol combination. After administering 2 mcg kg-1 intravenous fentanyl, three groups were formed: one given 2.5 mg kg-1 propofol, another 0.3 mg kg-1 eto- midate, and the third 1 mg kg-1 propofol + 0.1 mg kg-1 etomidate [23]. LMA placement occurred after the loss of the eyelash reflex and no response to verbal commands. The main result of the study indicated that etofol, the etomidate- propofol combination, produced more stable hemodynamics compared to using propofol and etomidate alone. Even with reduced doses of both drugs in the etomidate-propofol com-bination, the study reported a more stable hemodynamic state and better conditions for LMA placement. This suggests that combining etomidate and propofol can offer advantages in terms of hemodynamic stability and procedural conditions during the placement of the laryngeal mask airway, which is valuable information for anesthesiologists and healthcare professionals involved in anesthesia administration [24]. The present study has several notable limitations. Firstly, the study did not utilize Bispectral Index (BIS) measurements to assess loss of consciousness and determine the depth of anesthesia. BIS is a valuable tool for monitoring the depth of anesthesia and can provide essential insights into the patient's awareness and response to stimuli during the induction process. Incorporating BIS measurements could have enriched the understanding of the anesthetic effects and consciousness levels achieved by the different drugs and combinations used. Secondly, the study did not measure plasma cortisol and adrenocorticotropic hormone levels. This is significant considering that etomidate, a drug used in the study, is known to cause adrenocortical suppression. Mon- itoring these hormonal levels could have provided insights into the potential effects of the anesthetics on the adrenal function, even though it's recognized that the adrenocortical suppression induced by a single dose of etomidate is usually transient and typically not clinically significant. [25]

V. CONCLUSION

The combination of etomidate and propofol appears to offer a valuable alternative in clinical situations where it is necessary to avoid the extreme hypotensive (low blood pressure) and hypertensive (high blood pressure) responses that can be induced by either propofol or etomidate when used indi- vidually. By combining these two agents, it's possible to achieve a more stable hemodynamic profile during anesthesia induction, reducing the risk of significant blood pressure fluctuations. This approach is particularly advantageous in cases where maintaining stable blood pressure is critical for patient safety and well-being, such as in patients with cardiovascular conditions or those at risk of hemodynamic instability. The ability to fine-tune the anesthetic effect while minimizing adverse hemodynamic effects can enhance the overall management of anesthesia and improve patient out- comes.However, it's essential to consider the specific patient population, the clinical context, and individual patient factors when deciding on the most appropriate anesthesia induction method. Healthcare professionals should carefully evaluate the benefits and potential risks associated with the use of any anesthetic combination to ensure the best possible care for their patients. [26], [27]

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors equally contributed to preparing this article.

REFERENCES

[1] Lim YS, Kang DH, Kim SH, Jang TH, Kim KH, Ryu SJ, et al. The cardiovascular effects of midazolam co- induction to propofol for in- duction in aged patients. Korean J Anesthesiol 2012;62(6):536-542. doi: 10.4097/kjae.2012.62.6.536.

Journal of Chemical Health Risks

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[2] Cressey DM, Claydon P, Bhaskaran NC, Reilly CS. Effect of midazolam pretreatment on induction dose requirements of propofol in combination with fentanyl in younger and older adults. Anaesthesia 2001;56(2):108- 113. doi:10.1046/j.1365- 2044.2001.01789.x

[3] Reves JG, Glass PSA, Lubarsky DA, McEvoy MD. Intravenous nonopioid anesthetics. In: Miller RD, ed. Miller's Anesthesia. 6th ed. Philadelphia: Churchill Livingstone; 2005:317-378.

[4] Canbay O, Celebi N, Arun O, Karagoz AH, Saricao?lu F, Ozgen S. Efficacy of intravenous acetaminophen and lidocaine on propofol injection pain. Br J Anaesth 2008;100:95-98. doi:10.1093/bja/aem301

[5] Guzelmeric F, Erdo?an HB, Kocak T. Kardiyak acillerde anestezik yakla??m. Turk Go?us Kalp Damar Cer Derg 2007;15(1):82-89.

[6] Mota J, Soares-Miranda L, Silva JM, Dos Santos SS, Vale S. Influ-ence of body fat and level of physical activity on rate-pressure prod-uct at rest in preschool children. Am J Hum Biol 2012;24(5):661-665. doi:10.1002/ajhb.22294

[7] Kayhan Z. Klinik Anestezi. 2. bask?, Logos Yay?nc?l?k. (In Turkey). Istanbul;1997;272-273.

[8] Sawano Y, Miyazaki M, Shimada H, Kadoi Y. Optimal fentanyl dosage for attenuating systemic hemodynamic changes, hormone release and cardiac output changes during the induction of anesthesia in patients with and without hypertension: a prospective, randomized, double-blinded study. J Anesth 2013;27(4):505-511. doi:10.1007/s00540- 012-1552-x.

[9] Moher D, Hopewell S, Schulz KF, Montori V, Gotzsche PC, Devereaux PJ, et al. Consort 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. Int J Surg 2012;10(1):28- 55. doi:10.1016/j.ijsu.2011.10.001.

[10] Whitwam JG. Co-induction of anaesthesia: day-case surgery. Eur J Anaes- thesiol Suppl 1995;12:25-34.

[11] Anderson L, Robb H. A comparison of midazolam co-induction with propofol predosing for induction of anaesthesia. Anaesthesia 1998;53(11):1117-1120. doi:10.1046/j.1365-2044.1998.00560.x.

[12] Morgan M, Lumley J, Whitwam JG. Respiratory effects of etomidate. BrJ Anaesth 1977;49(3):233-236. doi:10.1093/bja/49.3.233.

[13] Hosseinzadeh H, Golzari SE, Torabi E, Dehdilani

[14] Hemodynamic changes following anesthesia induction and LMA insertion with propofol, etomidate, and propofol + etomidate. J Cardiovasc Thorac Res 2013;5(3):109-112. doi:10.5681/ jcvtr.2013.023.

[15] Saricaoglu F, Uzun S, Arun O, Arun F, Aypar U. A clinical comparison of etomidate-lipuro, propofol and admixture at induction. Saudi J Anaesth 2011;5(1):62-66. doi:10.4103/1658-354X.76509.

[16] Jain U, Laflamme CJ, Aggarwal A, Ramsay JG, Comunale ME, Ghoshal S, et al. Electrocardiographic and hemodynamic changes and their asso- ciation with myocardial infarction during coronary artery bypass surgery. A multicenter study. Multicenter Study of Perioperative Ischemia (McSPI) Research Group. Anesthesiology 1997;86(3):576-591.

[17] Reich DL, Bodian CA, Krol M, Kuroda M, Osinski T, Thys DM. Intraoper- ative hemodynamic predictors of mortality, stroke, and myocardial infarc- tion after coronary artery bypass surgery. Anesth Analg 1999;89(4):814- 822. doi:10.1213/00000539- 199910000-00002.

[18] Reich DL, Hossain S, Krol M, Baez B, Patel P, BernsteinA, et al. Predictors of hypotension after induction of general anesthesia. Anesth Analg 2005;101(3):622- 628. doi:10.1213/01.ANE.0000175214.38450.91.Hosse inzadeh H, EidyM, Golzari SE, Vasebi

[19] Hemodynamic stability during induction of anesthesia in elderlyPatients: propofol + ketamine versus propofol + etomidate. J Cardiovasc Thorac Res2013;5(2):51-54. doi:10.5681/jcvtr.2013.011

[20] Wagner RL, White RF, Kan PG, Rosenthal MH, Feldman D. Inhibition of adrenal steroidogenesis by the anesthetic etomidate. N Engl J Med 1984;310(22): 1415-1421. doi: 10.1056/NEJM198405313102202

[21] Giese JL, Stockham RJ, Stanley TH, Pace NL, Nelissen RH. Eto- midate versus thiopental for induction of anesthesia. Anesth Analg 1985;64(9):871-876.

[22] Larsen R, Rathgeber J, Bagdahn A, Lange H, Rieke

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 912-917 | ISSN:2251-6727

[23] H. Effects of propofol on cardiovascular dynamics and coronary blood flow in geriatric patients. A comparison with etomidate. Anaesthesia 1988;43 (Suppl):25-31.

[24] Bergen JM, Smith DC. A review of etomidate for rapid sequence intu- bation in the emergency department. J Emerg Med 1997;15(2):221-230. doi:10.1016/S0736- 4679(96)00350-2.

[25] Karcioglu M, Davarci I, Kirecci N, Akcay AB, Turhanoglu S, Tuzcu K, et al. The development of ventricular fibrillation due to etomidate for anesthetic induction: a very rare side effect, case report. Braz J Anesthesiol 2014;64(5):365-368. doi:10.1016/j. bjan.2013.06.010.

[26] Moller Petrun A, Kamenik M. Bispectral index-guided induction of general anaesthesia in patients undergoing major abdominal surgery using propofol or etomidate: a double-blind, randomized, clinical trial. Br J Anaesth 2013;110(3):388-396. doi:10.1093/ bja/aes416.

[27] Ulsamer B, Raps M. Induction of anesthesia using propofol in comparison with etomidate. Anaesthesist 1988;37(8):517-521.