Open Access

Original Article

Hemodynamic Changes with Propofol and Etomidate During Induction of Anaesthesia in Controlled Hypertensive Patients

Muhammad Wasib, Usman Khalid, Faisal Wahid, Attique Ur Rehman Orkzai, Rana Faizan Asghar, Najaf Imtiaz

Department of Anaesthesia, Combined Military Hospital, Malir/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To determine the mean hemodynamic changes with etomidate and propofol during anaesthetic induction in controlled hypertensive patients.

Study Design: Quasi experimental study.

Place and Duration of Study: Anaesthesia Department, Combined Military Hospital Malir, Karachi, Pakistan from Mar 2019 to Mar 2020.

Methodology: After permission from the Institutional Ethical Review Committee, a sample size of 70 controlled hypertensive patient sundergoing surgery under general anaesthesia of ages between 30-60 years of either gender were included in the study and placed in two groups. Group-A included those who were given injection propofol and Group-B consisted of those who received injection etomidate. Determination of mean hemodynamic changes with propofol in comparison with etomidate during induction of anaesthesia was the primary outcome. Results recorded and analyzed thereafter for conclusion.

Results: The mean variation of heart rate (HR) in Group-A and Group-B was 76.80±7.74 bpm and 79.49±9.33 bpm respectively. Mean variation in systolic blood pressure (SBP) was 130.14±13.30 mm of Hg and 137.09±13.66 mm of Hg. Mean diastolic blood pressure (DBP) between propofol and etomidate was 76.80±7.74 mm of Hg and 79.49±9.33 mm of Hg. The analysis between two groups was made keeping in mind the variables of HR, SBP and DBP. It showed etomidate was a better choice for induction.

Conclusion: We concluded that hemodynamic control is better with etomidate than propofol during induction of anaesthesia in controlled hypertensive patients.

Keywords: Etomidate, Hemodynamic response, Hypertension, Propofol.

How to Cite This Article: *Wasib M, Khalid U, Wahid F, Orkzai AUR, Asghar RF, Imtiaz N. Hemodynamic Changes with Propofol and Etomidate During Induction of Anaesthesia in Controlled Hypertensive Patients. Pak Armed Forces Med J 2026; 76(Suppl-8): S1212-S1216.*
DOI: https://doi.org/10.51253/pafmj.v76iSUPPL-8.10087

INTRODUCTION

Induction during general anaesthesia causes myocardial depression, vasodilatation and autonomic stimulation leading to hemodynamic changes in terms of decreased blood pressure.[1] Laryngoscopy and intubation during anaesthesia can result in tachycardia and dysrythmias. It can also cause sympathetic nervous system stimulation, resulting in short term surge in blood pressure and increase in heart rate.[2]

Mostly used intravenous (IV) agents are propofol, etomidate, midazolam, ketamine and opioids.[3] Drugs, other than ketamine, act by increasing the activity of the inhibitory neurotransmitter Gamma Amino butyric Acid (GABA) in CNS.

Currently, the most widely used IV anaesthetic induction agent is propofol. Due to its highly lipophilic property it distributes rapidly into the CNS and other tissues causing rapid onset of action.[4,5] Propofol, being myocardial depressant, decreases blood pressure by decreasing pre and after load, reduced cardiac output and decreased systemic vascular resistance.[6]

Etomidate lacks analgesic properties, is short acting with rapid onset, causes least depression of myocardium with minimal adverse effects, including respiratory depression.[7,8] However, it may cause transient hypertension as a result of stimulation of sympathetic response due to lack of analgesia. Its property of increasing coronary perfusion makes it an agent of choice in patients undergoing surgery with mild to moderate cardiac dysfunction. Etomidate, in the past fell out of use due to adrenocortical suppression.[9]

Hemodynamic changes are defined as a change in heart rate (heart less than 60 taken as Bradycardia and greater than 110 taken as Tachycardia), systolic and diastolic blood pressures at different intervals before and after induction (within 30 min).

Correspondence: Dr Usman Khalid, Department of Anaesthesia, Combined Military Hospital, Malir Pakistan
Received: 14 Apr 2023; revision received: 16 May 2023; accepted: 17 May 2023

Hypertension is defined as systolic blood pressure >80% of the base line value or >140 mmHg. Hypotension is labeled if systolic blood pressure < 80% of baseline or <90 mmHg.[10]

The rationale of the study was to establish the superiority of etomidate compared to propofol in hypertensive patients.

METHODOLOGY

This quasi-experimental study was carried out in Anaesthesia Department, Combined Military Hospital Malir Cantt., Karachi, Pakistan from March 2019 to March 2020, after approval from the Institutional Ethical Review Committee (IERB number # 38/2019/Trg/ERC).

Inclusion Criteria: Patients of either gender aged between 30 to 60 years, with controlled blood pressure (≤ 140/90 mm Hg) with antihypertensive medicines, and had ASA grade I/II, were included.

Exclusion Criteria: Patients taking beta blockers, with any organ damage, undergoing emergency surgery or having other co morbid (e.g COPD, diabetes or allergy) were excluded.

Sample size of 70 was calculated by WHO sample size calculator for hypothesis testing for two populations with following assumptions: anticipated mean heart rate with propofol being 74.54 and anticipated mean heart rate with etomidate being 78.01.[10]

Informed consent was taken prior to data collection, and non-probability consecutive sampling was used. Detailed history and preanaesthetic assessment was carried out a day before surgery and in the pre induction room on the day of surgery. Premedication was carried out with injection metoclopramide 10 mg and injection dexamethasone 8 mg. Two equal groups of patients were designated: In Group-A anaesthesia was inducted with injection propofol (1-2.5 mg/kg) and in Group-B with injection etomidate (0.2-0.5 mg /kg) and maintained with mixture of air and oxygen 1:1 and isoflurane 1.2 % (Figure-1). Muscle relaxation was achieved with injection atracurium (0.5 mg/kg). Patients were intubated 3 minutes after administration of neuromuscular blocking agent. Standard monitoring was applied to all patients.

Hemodynamic parameters of the patients including heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were noted at following fixed intervals in data collection form. Time zero (T 0) was considered as baseline before induction then at 1minute, 3 minutes, 5 minutes, 10 minutes, 15 minutes and 30 minutes (T1, T2, T3, T4, T5, T6 respectively).

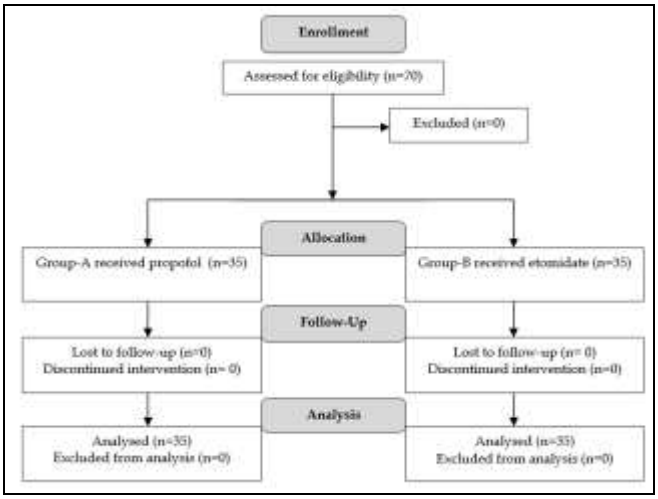

Figure: Patient Flow Diagram (n=70)

Statistical Package for Social Sciences (SPSS) version 23 was used to analyze data. Descriptive statistics were used for qualitative and quantitative variables. Qualitative data like gender was expressed as percentages. Quantitative data like age, HR, SBP and DBP were expressed as Mean±SD. The analysis between two groups was made using independent samples t-test. A *p*-value≤0.05was taken as statically significant.

RESULTS

Demographics like age and gender are compared in Table-I. Patients between ages of 30 to 60 years were taken with mean age of 45.76±7.23 years. The mean age in Group-A was 44.14±8.91 years and in Group-B was 46.29±7.04 years. Most of the patients 36(51.43%) were between 30 to 45 years of age. Total number of patients was 70, out of which males were 31(44.29%) and females 39 (55.71%), with a male to female ratio of 1:1.3.

Table-I: Demographics of Study Groups (n=70)

		Group-A n=35 n (%)	Group-B n=35 n (%)
Age (Years)	30-45	20 (57.14)	16 (45.71)
	36-60	15 (42.86)	19 (54.29)
Gender	Male	18 (51.43)	13 (37.14)
	Female	17 (48.57)	22 (62.86)

Determination of mean hemodynamic changes with propofol in comparison with etomidate during

induction of anaesthesia was the primary outcome. In our study, mean variation of heart rate with propofol and etomidate were 88.39±9.91 versus 87.19±10.22 at first minute, 71.23±9.34 bpm versus 87.19±10.22bpm at 2nd minute, 70.98±10.23bpm versus 74.89±9.11bpm at 3rnd minute, 70.98±10.23bpm vesus 75.12±10.03bpm at 5th minute, 74.61±12.39 versus 78.12±10.17 bpm at 10th minute, 75.67±9.89 versus 79.62±9.69 bpm at 15th minute and 77.29±10.67 versus 80.12±10.03 bpm at half hour respectively. The mean average heart rate was 76.80±7.74 in Group-A and 79.49±9.33 bpm in Group-B (p=0.194). The results are displayed in Table-II. Similarly, the blood pressure of the patients in Group-A and Group-B was 88.39±9.91 versus 87.19±10.22 mm of Hg, 71.23±9.34 versus 74.89±9.11 mm of Hg, 70.98±10.23 versus 75.12±10.03 mm of Hg, 74.61±12.39 versus 78.12±10.17 mm of Hg, 75.67±9.89 versus 79.62±9.69 mm of Hg, 77.29±10.67 versus 80.12±10.03 mm of Hg at the 1st, 3rd, 5th, 10th, 15th, and 30th minute respectively. The p-values can be seen in Table-III.

Table-II: Comparison of Mean Heart Rate with Propofol and Etomidate during Induction of Anesthesia in Controlled Hypertensive Patients (n=70)

Time (minutes)	Group-A (n=35) Mean±SD	Group-B (n=35) Mean±SD	p-value
	Beats per Minute	Beats per Minute	
Baseline	91.45 ± 9.98	90.51 ± 9.21	0.684
1	88.39 ± 9.91	87.19 ± 10.22	0.619
3	71.23 ± 9.34	74.89 ± 9.11	0.102
5	70.98 ± 10.23	75.12 ± 10.03	0.092
10	74.61 ± 12.39	78.12 ± 10.17	0.199
15	75.67 ± 9.89	79.62 ± 9.69	0.096
30	77.29 ± 10.67	80.12 ± 10.03	0.257
Average	76.80 ± 7.74	79.49 ± 9.33	0.194

Table-III: Comparison of Mean Systolic Blood Pressure with Propofol and Etomidate during Induction of Anesthesia in Controlled Hypertensive Patients (n=70)

Time (minutes)	Group-A (n=35) Mean±SD	Group-B (n=35) Mean±SD	p-value
	Mean Systolic Blood Pressure (mm of Hg)	Mean Systolic Blood Pressure (mm of Hg)	
Baseline	137.22± 9.78	141.31±10.33	0.094
1	136.33±8.79	138.67±11.89	0.353
3	136.01±8.42	137.22±9.78	0.581
5	134.43±9.12	136.33±8.79	0.378
10	132.58±10.89	134.43±9.12	0.444
15	131.01±9.89	132.58±10.89	0.529
30	128.56±8.79	133.78±11.09	0.032
Average	130.14±13.30	137.09±13.66	0.035

The difference in diastolic blood pressure in both groups (Group-A versus Group-B) was 81.23±9.34 versus 84.89±9.11, 88.39±9.9 versus 87.19±10.22, 70.98±10.23 versus 75.12±10.03, 74.61±12.39 versus 78.12 ± 10.1 and 77.29±10.67 versus 80.12±10.03 mm of Hg. The mean average diastolic blood pressure was 76.80±7.74 versus 79.49±9.33 in Group-A versus Group-B (p=0.194), as presented in Table-IV.

Table-IV: Comparison of Mean Diastolic Blood Pressure with Propofol and Etomidate during Induction of Anesthesia in Controlled Hypertensive Patients (n=70)

Time (minutes)	Group-A (n=35) Mean±SD	Group-B (n=35) Mean±SD	p-value
	Mean Diastolic Blood Pressure (mm of Hg)	Mean Diastolic Blood Pressure (mm of Hg)	
Baseline	81.23 ± 9.34	84.89 ± 9.11	0.102
1	80.98 ± 10.23	85.12 ± 10.03	0.092
3	84.61 ± 12.39	78.12 ± 10.17	0.019
5	75.67 ± 9.89	79.62 ± 9.69	0.096
10	75.89 ± 10.09	79.98 ± 11.03	0.110
15	76.89 ± 11.01	80.89 ± 9.11	0.102
30	77.29 ± 10.67	80.12 ± 10.03	0.002
Average	76.80 ± 7.74	79.49 ± 9.33	0.194

DISCUSSION

Airway management is considered to be one of the most important aspects of patient care during anaesthesia. The gold standard for airway protection is endotracheal intubation.[10] It protects the airways delivers inhalational agents and prevents aspiration. Laryngoscopy causes stimulation of stress response which can lead to hemodynamic changes. The most effected group of patients includes those with risk factors for ischemic heart disease and hypertension.[9] Laryngoscopy causes increased blood pressure with tachycardia, leading to myocardial ischemia, hypoxia and infarction.

One of the most commonly used intravenous induction agent, is propofol.[11] It is a short acting drug with recommended induction dose of 2-2.5 mg/kg.[12] Hemodynamic instability and bradycardia are the most undesirous effect of propofol which lead to cardiovascular complications. Pain at the site of injection is the most commonly encountered side effect by patients.[13] Etomidate, due to its property of no histamine release is a cardiostable hypnotic drug. The most widely encountered side effects of etomidate include nausea and vomiting, which can be a risk factor for aspiration. Burning at the site of injection is also encountered with etomidate. Hemodynamic stability is witnessed with etomidate during laryngoscopy, while giving anaesthesia.

In the current study, the mean variation of heart rate with propofol and etomidate was 76.80 ±7.74 and 79.49±9.33 respectively. Mean variation in systolic

blood pressure was 130.14±13.30 and 137.09±13.66 across groups. Mean diastolic blood pressure in groups A and B were 76.80±7.74 and 79.49±9.33 respectively.

Another study conducted showed that mean variation in heart rate with propofol and etomidate was 74.54±5.67 and 78.01±5.12 respectively.[4] Mean variation in systolic blood pressure was 122.1±8.01 and 129.56±8.01 and 129.56±12.34.[14] Mean diastolic blood pressure between 2 drugs was 80.08±8.1 and 85.2±7.01.4 Das *et al*. also supported this in their study.[2] As per a study conducted by Moller *et al*. significant decrease in variables was witnessed in both groups.[15] According to study conducted by Kaushal *et al*. there was an insignificant decrease in both groups, however, more hemodynamic stability was seen with etomidate as compared to propofol.[16]

Considering the changes in blood pressures, our study showed a significant change in mean SBP with propofol, but when etomidate was used as induction agent the change was not that significant. This was also supported by multiple studies, including one that witnessed a noteworthy decrease in SBP 5 min after induction with propofol from 150.2 to 99.66.4.16 Ding et al. too, in their study advocated the decrease in both groups was significant.[14]

The extent of change in level of MAP, SBP and DBP was greater from baseline when propofol was used. Multiple factors lead to arterial hypotension following induction with intravenous drugs. Etomidate lacks the effect, both on baroreceptor function and sympathetic stimulation, it also lacks the capacity to bind and stimulate peripheral alpha 2B adrenergic receptors, all these factors can be the reason for hemodynamic stability seen with etomidate.[17] Propofol, on the other hand, by reducing pre and after load due to vasodilatation along with myocardial depression leads to decreased systemic blood pressure.[18]

Saricaoglu *et al*. in his study on hemodynamic effects of both etomidate and propofol, attributed negative inotropic effect of propofol to be the reason for significant decrease in blood pressure and resultant hypotension.[19] Effects on myocardium by propofol were studied by Larsen *et al*.[20] The changes in left ventricular function were noted using transthoracic tissue doppler echocardiography, the conclusion made by this study showed that that reduced cardiac filling and negative inotropic effect of propofol led to decreased MAP.[19] Another study that favored etomidate concluded the significant decrease in MAP was seen when propofol was used for induction.[15] Etomidate, by preserving the sympathetic outflow and autonomic reflexes is considered better induction agent when compared to propofol as minimal changes in hemodynamic parameters were seen after induction with etomidate.[16]

LIMITATIONS OF STUDY

General anaesthesia was given by consultant anesthesiologists who had good dexterity; therefore, bias could have been possible in success rate.

CONCLUSION

This study concluded that during induction of anaesthesia the hemodynamic control is better with etomidate than propofol in controlled hypertensive patients. So, we recommend that for induction of anesthesia in controlled hypertensive patients, etomidate should be used in order to prevent the hemodynamic changes secondary to laryngoscopy and tracheal intubation.

Conflict of Interest: None.

Discolure:

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MW & UK: Data acquisition, data analysis, critical review, approval of the final version to be published.

FW & AURO: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

RFA & NI: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Shah SB, Chowdhury I, Bhargava AK, Sabbharwal B. Comparison of hemodynamic effects of intravenous etomidate versus propofol during induction and intubation using entropy guided hypnosis levels. J Anaesthesiol Clin Pharmacol 2015; 31(2): 180. https://doi.org/10.4103/0970-9185.155145
2. Das M, Pradhan BK, Samantray R. Comparative study on haemodynamic responses during intubation using etomidate, propofol and thiopentone in laparoscopic cholecystectomy surgeries. Innov J Med Health Sci 2015; 5(4): 150–158. https://doi.org/10.15520/ijmhs.2015.vol5.iss4.80.150-158
3. Velásquez JA, Rodríguez J, Higuita-Gutiérrez L, Vergara MM. A systematic review and meta-analysis of the hemodynamic effects of etomidate versus other sedatives in patients undergoing rapid sequence intubation. Rev Esp Anestesiol Reanim Engl Ed 2022; 69(10): 663-673. https://doi.org/10.1016/j.redare.2021.05.020

4. Shah J, Patel I, Guha A. Comparative study of propofol vs etomidate as an induction agent to evaluate hemodynamic changes during induction of anesthesia in controlled hypertensive patients. Anaesth Pain Intensive Care 2019; 361–367.
5. Biswal P, Singh S, Taank P. Application of 'Priming Principle'on the induction dose requirements of propofol-A Randomized Clinical Trial. Int J Biomed Res 2018; 9(09): 320–324. https://doi.org/10.7439/ijbr
6. Aggarwal S, Goyal VK, Chaturvedi SK, Mathur V, Baj B, Kumar A. A comparative study between propofol and etomidate in patients under general anesthesia. Rev Bras Anestesiol 2016; 66(3): 237–241. https://doi.org/10.1016/j.bjane.2014.10.005
7. Nazeer T, Tahir A, Khan M, Din ST, Shoaib M, Asif M. Comparison of propofol and etomidate in haemodynamic changes at the time of induction of general anaesthesia. Pak J Med Health Sci Apr 2021;15(4): 685–687.
8. Rathore VS, Singh S, Taank P, Khandelwal A, Kaushal A. Clinical analysis of propofol, etomidate and an admixture of etomidate and propofol for induction of general anaesthesia. Turk J Anaesthesiol Reanim 2019; 47(5): 382. https://doi.org/10.5152/TJAR.2019.53806
9. DiMaria S, Mangano N, Bruzzese A, Bartula B, Parikh S, Costa A. Genetic variation and sex-based differences: current considerations for anesthetic management. Curr Issues Mol Biol 2025; 47(3): 202. https://doi.org/10.3390/cimb47030202
10. Dietrich SK, Mixon MA, Rogoszewski RJ, Delgado SD, Knapp VE, Floren M. Hemodynamic effects of propofol for induction of rapid sequence intubation in traumatically injured patients. Am Surg 2018; 84(9): 1504-1508. https://doi.org/10.1177/000313481808400959
11. Fawcett W. Suxamethonium or rocuronium for rapid sequence induction of anaesthesia? BJA Educ 2019; 19(12): 380. https://doi.org/10.1016/j.bjae.2019.09.001
12. Dai ZL, Cai XT, Gao WL, Lin M, Lin J, Jiang YX, et al. Etomidate vs propofol in coronary heart disease patients undergoing major noncardiac surgery: a randomized clinical trial. World J Clin Cases 2021; 9(6): 1293. https://doi.org/10.12998/wjcc.v9.i6.1293
13. Tarwade P, Smischney NJ. Endotracheal intubation sedation in the intensive care unit. World J Crit Care Med 2022; 11(1): 33. https://doi.org/10.5492/wjccm.v11.i1.33
14. Ding T, Hu YL. Comparison of etomidate and propofol-mediated anesthesia induction followed by intubation and sevoflurane maintenance during ERCP in obese patients. Am J Transl Res 2021; 13(8): 9853.
15. Möller PA, 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. https://doi.org/10.1093/bja/aes416
16. Kaushal RP, Vatal A, Pathak R. Effect of etomidate and propofol induction on hemodynamic and endocrine response in patients undergoing coronary artery bypass grafting/mitral valve and aortic valve replacement surgery on cardiopulmonary bypass. Ann Card Anaesth 2015; 18(2): 172. https://doi.org/10.4103/0971-9784.154470
17. Pandey AK, Makhija N, Chauhan S, Das S, Kiran U, Bisoi AK, et al. The effects of etomidate and propofol induction on hemodynamic and endocrine response in patients undergoing coronary artery bypass graft surgery on cardiopulmonary bypass. World J Cardiovasc Surg 2012; 2(3): 48-53. https://doi.org/10.4236/wjcs.2012.23011
18. Gropper MA, Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, et al. Miller's anesthesia, 2-volume set E-book. Elsevier Health Sciences; 2019. Available from: https://books.google.com.pk/books?hl=en&lr=&id=AcsVEQAAQBAJ&oi=fnd&pg=PP1&dq=+Gropper+MA,+Miller+RD,+Eriksson+LI,+Fleisher+LA,+Wiener-Kronish+JP,+Cohen+NH,+et+al.+Miller%E2%80%99s+anesthesia,+2-volume+set+E-book.+Elsevier+Health+Sciences%3B+2019.+&ots=S3TEUH3qYZ&sig=6rIw21kbSF_VIl13wXoBXPjRdlo&redir_esc=y#v=onepage&q&f=false
19. 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. https://doi.org/10.4103/1658-354X.76509
20. Larsen J, Torp P, Norrild K, Sloth E. Propofol reduces tissue-Doppler markers of left ventricle function: a transthoracic echocardiographic study. Br J Anaesth 2007; 98(2): 183–188. https://doi.org/10.1093/bja/ael345