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Original Research Article

Comparative Analysis of Hemodynamic Responses to Propofol and Etofol during Elective Surgery Induction

Nikulbhai Jivanbhai Prajapati[1], Hardul Vasantkumar Modi[2], Akshaykumar Vinodbhai Pandya[3]

[1,2]Associate Professor, Department of Anesthesia, Nootan Medical College and Research Center, Visnagar, Gujarat, India

[3]Assistant Professor, Department of Anesthesia, Nootan Medical College and Research Center, Visnagar, Gujarat, India

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Corresponding Author: Dr. Akshaykumar Vinodbhai Pandya

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Abstract:

Background: The selection of an ideal induction agent for general anaesthesia is pivotal in ensuring intraoperative hemodynamic stability. While propofol is widely preferred for its rapid onset and smooth recovery, it is often associated with hypotension. Etofol, a novel combination of etomidate and propofol, is being explored for its ability to preserve cardiovascular function during induction.

Aim: To evaluate and compare the hemodynamic effects of propofol and etofol as induction agents in elective surgeries under general anaesthesia.

Materials and Methods: A prospective, randomized, double-blinded study was conducted on 80 adult patients undergoing elective surgeries. Patients were divided into two groups: Group I (n=40) received propofol 2 mg/kg and Group II (n=40) received etofol (etomidate 0.15 mg/kg + propofol 1 mg/kg) Hemodynamic parameters—heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP)—were recorded at baseline, during induction, and at intervals up to 60 minutes post-induction.

Results: Baseline parameters were comparable between the two groups. Group II (etofol) exhibited significantly higher SBP, DBP, and MAP at all post-induction time points ($p < 0.001$), indicating better cardiovascular stability. Group I (propofol) showed marked hypotension following induction. HR was mostly comparable, though a significant difference was noted at 1 minute post-induction ($p = 0.041$).

Conclusion: Etofol demonstrates superior hemodynamic stability compared to propofol during induction of general anaesthesia. It may serve as a safer and more effective alternative in patients where maintaining blood pressure is critical.

Keywords: Etofol, Propofol, Etomidate, Hemodynamic stability, General anaesthesia, Induction agents.

Introduction

The induction phase of general anaesthesia plays a critical role in determining the perioperative outcomes of patients undergoing elective surgeries. Among the plethora of induction agents available, propofol remains the most commonly administered due to its favourable pharmacokinetic profile, including rapid onset and smooth recovery [1].

Despite these advantages, propofol is notorious for causing significant cardiovascular depression, leading to hypotension, bradycardia, and decreased systemic vascular resistance—particularly in patients with limited cardiac reserve [2,3]. These hemodynamic disturbances may contribute to delayed recovery and increased perioperative risk. In an attempt to counter these drawbacks, various modified agents have been developed. One such innovation is Etofol, a combination of etomidate and propofol formulated to combine the desirable properties of both drugs. Etomidate, a non-barbiturate hypnotic agent, is known for inducing anaesthesia with minimal effects on heart rate and blood pressure. Its ability to maintain cardiovascular stability has made it a preferred agent in critically ill patients and those with compromised myocardial function [4,5].

However, its use has been marred by side effects such as myoclonus, adrenocortical suppression, and postoperative nausea and vomiting [6]. Etofol aims to offer the hemodynamic neutrality of etomidate with the faster recovery profile and antiemetic properties of propofol, thereby creating a more balanced induction experience [7]. The combination is designed to minimize the extreme hypotension caused by propofol, while also

mitigating the adrenal suppression and myoclonic movements associated with etomidate. Studies suggest that this fusion results in better patient outcomes in terms of cardiovascular stability, smoother induction, and faster awakening with fewer complications [8,9]. Furthermore, the exploration of such combination agents is particularly relevant in modern anaesthesia practice, which emphasizes Enhanced Recovery after Surgery (ERAS) protocols, aiming to minimize perioperative stress and improve recovery timelines. In this light, identifying an induction agent that is both effective and hemodynamically stable becomes crucial for surgical success, patient safety, and resource efficiency [10].

Despite global interest, limited comparative studies have been conducted in Indian tertiary care settings to evaluate the real-time hemodynamic profiles of these agents. Therefore, this study is undertaken to compare and evaluate the hemodynamic effects of propofol and etofol as induction agents in patients undergoing elective surgeries under general anaesthesia, with the goal of determining a more optimal anaesthetic strategy tailored for safer and more effective perioperative care.

Material and Methods

This was a prospective, randomized, double-blinded, comparative study conducted to evaluate and compare the hemodynamic effects of propofol and etofol as induction agents in elective surgeries under general anaesthesia. The study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital for the duration of 1 year. A total of 80 patients scheduled for elective surgeries under general anaesthesia were enrolled in the study. The participants were randomly allocated into two groups of 40 patients each using a computer-generated randomization sequence.

Inclusion Criteria

- Patients aged between 18–60 years.
- American Society of Anesthesiologists (ASA) physical status I or II.
- Undergoing elective surgical procedures under general anaesthesia.
- Provided informed written consent.

Exclusion Criteria

- Patients with known hypersensitivity to propofol or etomidate.
- Patients with cardiovascular instability or severe systemic diseases.
- Pregnant or lactating women.
- Patients on long-term corticosteroid therapy.
- Anticipated difficult airway.

Group Allocation

- Group I (Propofol Group): Received 2 mg/kg of propofol intravenously as the induction agent.
- Group II (Etofol Group): Received a combination of 0.15 mg/kg etomidate and 1 mg/kg propofol intravenously as the induction agent.

All patients were premedicated with Inj. midazolam 0.05 mg/kg and Inj. fentanyl 2 µg/kg IV 5 minutes before induction. Standard ASA monitoring including ECG, non-invasive blood pressure (NIBP), and pulse oximetry was instituted before induction.

The assigned induction agent was administered intravenously over 30–60 seconds by an anaesthesiologist unaware of the group allocation. Tracheal intubation was performed 90 seconds after administration using Inj. succinylcholine 1.5 mg/kg IV. Anaesthesia was maintained with oxygen, nitrous oxide, and isoflurane as per standard protocol.

Hemodynamic parameters including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded at the following intervals:

- Baseline (before induction)
- Immediately after induction
- At 1, 3, and 5 minutes post-induction
- After tracheal intubation

Both the patients and the anaesthesiologist recording the vitals were blinded to the group allocation. The preparation and administration of the induction agents were done by a separate anaesthesiologist not involved in data collection.

Statistical Analysis

All data were entered into Microsoft Excel and analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation and compared using unpaired t-test. Categorical variables were compared using Chi-square test. A p-value of <0.05 was considered statistically significant.

The study protocol was reviewed and approved by the Institutional Ethics Committee prior to commencement. Informed written consent was obtained from all participants.

Results

Table 1 compares the demographic characteristics of patients in both groups. The mean age and weight were comparable between Group I (Propofol) and Group II (Etofol), with no statistically significant differences ($p > 0.05$). The gender distribution was also similar, showing balanced randomization between both study arms. These findings suggest that the baseline characteristics were homogenous and did not

introduce any selection bias. Table 2 shows the trend of heart rate (HR) at various time intervals between the two groups. While the baseline and most post-induction time points showed no significant differences, a statistically significant increase in heart rate was noted at 1 minute post-induction in Group II compared to Group I ($p = 0.041$). This transient rise in HR in the Etofol group may reflect a more stable compensatory response to induction.

Table 3 presents the changes in systolic blood pressure (SBP). While baseline values were similar in both groups, there was a highly significant difference ($p < 0.001$) at all subsequent time points post-induction. Group II (Etofol) maintained significantly higher SBP compared to Group I, indicating better preservation of hemodynamic stability following administration of the etofol combination. Table 4 highlights the changes in diastolic blood pressure (DBP) across the same time intervals. Again, no significant difference was found at baseline. However, from 0 minute onward, Group II maintained a consistently and significantly higher DBP compared to Group I ($p < 0.001$), confirming superior cardiovascular maintenance with etofol throughout the intraoperative period.

Table 5 illustrates the comparison of mean arterial pressure (MAP). Similar to SBP and DBP trends, there was no difference at baseline. However, all recorded intervals post-induction showed a statistically significant increase in MAP in the Etofol group ($p < 0.001$). These results reinforce the hemodynamic advantage of etofol, likely due to the stabilizing influence of etomidate in the combination.

Table 1: Comparison of Demographic Variables of Patients in Both Groups

Variables	Group I	Group II	P value	Statistical significance
Age (years)	38.10 ± 8.95	37.95 ± 9.12	0.782	NS
Gender (M/F)	22 / 18	20 / 20	0.514	NS
Weight (kg)	59.1 ± 1.9	58.9 ± 2.1	0.425	NS

Table 2: Comparison of Heart Rate (HR) Over Time between the Two Groups

Time	Group I (n=40)	Group II (n=40)	P value	Statistical significance
Baseline	82.2	81.9	0.901	NS
0 minute	74.5	76.2	0.248	NS
1 minute	70.8	75.4	0.041	S
2 minute	78.5	79.1	0.719	NS
5 minute	77.2	77.0	0.912	NS
10 minute	75.8	76.4	0.840	NS
30 minute	75.0	75.8	0.768	NS
60 minute	75.2	75.6	0.792	NS

Table 3: Comparison of Systolic Blood Pressure (SBP) Over Time

Time	Group I (n=40)	Group II (n=40)	P value	Statistical significance
Baseline	136.5	135.2	0.201	NS
0 minute	101.8	125.9	0.000	S
1 minute	93.5	121.3	0.000	S
2 minute	95.2	127.4	0.000	S
5 minute	96.8	126.5	0.000	S
10 minute	98.0	125.2	0.000	S
30 minute	98.6	127.0	0.000	S
60 minute	99.0	126.2	0.000	S

Table 4: Comparison of Diastolic Blood Pressure (DBP) Over Time

Time	Group I (n=40)	Group II (n=40)	P value	Statistical significance
Baseline	88.0	88.7	0.496	NS
0 minute	59.5	82.0	0.000	S
1 minute	57.2	77.5	0.000	S
2 minute	58.5	81.5	0.000	S
5 minute	57.9	80.5	0.000	S
10 minute	56.8	80.2	0.000	S
30 minute	59.0	79.8	0.000	S
60 minute	58.5	81.6	0.000	S

Table 5: Comparison of Mean Arterial Pressure (MAP) Over Time

Time	Group I (n=40)	Group II (n=40)	P value	Statistical significance
Baseline	103.5	104.0	0.473	NS
0 minute	73.4	96.9	0.000	S
1 minute	69.0	91.8	0.000	S
2 minute	70.2	96.8	0.000	S
5 minute	70.5	95.9	0.000	S
10 minute	71.0	95.4	0.000	S
30 minute	72.0	96.2	0.000	S
60 minute	72.6	96.5	0.000	S

Discussion

The findings of this study highlight significant differences in the hemodynamic profiles of propofol and etofol when used as induction agents in elective surgeries. While both groups were comparable demographically, Etofol demonstrated a consistent hemodynamic advantage, as reflected in the significantly higher SBP, DBP, and MAP values post-induction in Group II compared to Group I.

The hypotensive effect of propofol observed in Group I aligns with prior literature citing its potent vasodilatory and myocardial depressant properties [11]. A rapid fall in blood pressure during induction, as seen in the propofol group, may be undesirable, especially in patients with compromised cardiovascular status. In contrast, the Etofol combination, comprising 0.15 mg/kg etomidate and 1 mg/kg propofol, preserved hemodynamic parameters more effectively. The stability observed can be attributed to the inclusion of etomidate, known for its minimal cardiovascular suppression even in high-risk patients [12].

Our results are consistent with previous clinical trials where the combination of etomidate with propofol resulted in a more stable heart rate and arterial pressure profile compared to propofol alone [13]. This synergistic effect may be due to the balancing of propofol's vasodilation with etomidate's cardiovascular neutrality.

Notably, our study found that Etofol mitigated the sharp declines in SBP and DBP commonly associated with propofol, confirming the enhanced safety profile of the combination during induction. Moreover, the significant differences in MAP at all time points post-induction further substantiate the superior cardiovascular profile of Etofol.

These findings are supported by a recent meta-analysis which concluded that etofol provides adequate depth of anaesthesia without compromising hemodynamic integrity [14].

Although heart rate variations between groups were mostly insignificant, a mild but statistically significant elevation at the 1-minute mark in the Etofol group may reflect a transient sympathetic stimulation, which did not translate into any adverse outcomes. Overall, the favorable hemodynamic trends with Etofol make it a promising alternative, especially in patients where maintaining perfusion pressure is critical [15]. However, some limitations of the study should be acknowledged. The study was conducted on ASA I and II patients only, which may limit generalizability to higher-risk populations.

Furthermore, long-term postoperative outcomes and adrenal function were not assessed, particularly relevant in etomidate-containing formulations.

Conclusion

Etofol, a combination of etomidate and propofol, offers significantly better hemodynamic stability during induction compared to propofol alone. The combination effectively counters the hypotensive effects of propofol while preserving the smooth induction characteristics.

These findings support the use of Etofol as a safer and more hemodynamically balanced alternative for anaesthetic induction in elective surgeries, especially in patients where cardiovascular fluctuations pose a clinical concern.

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