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Comparative Evaluation of Sevoflurane–Fentanyl Versus Etomidate–Fentanyl for Anaesthetic Induction in Patients Undergoing Coronary Artery Bypass Graft Surgery

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Abstract:

- ***Background:***

The aim of this study was to compare the haemodynamic effects of sevoflurane with that of etomidate during anaesthetic induction in patients with coronary artery disease having good left ventricular function undergoing CABG and to assess time taken to achieve loss of consciousness and incidence of airway complications during induction.

- ***Methods:***

A double-blind prospective randomized, clinical study was performed on 100 patients with CAD having good left ventricular function (EF>50) scheduled for elective CABG surgery. Patients were randomly allocated to two group E and S. These patients received etomidate and sevoflurane at induction of anaesthesia, respectively. Haemodynamic variables (systolic and diastolic blood pressure [SBP, DBP], mean arterial pressure [MAP], central venous pressure[CVP]and heart rate [HR]) were measured and recorded at baseline, at induction and then at 1minute interval till 5 minutes post intubation.

- ***Results:***

Induction of anaesthesia was significantly faster in patients with etomidate as compared to patients who received sevoflurane. No airway complication was noted in patients who received either sevoflurane or etomidate. Vasopressor requirement was slightly higher in sevoflurane group as compared to etomidate group. However, these changes in haemodynamic parameters were not significant between the groups.

- ***Conclusion:***

Etomidate and Sevoflurane used as inducing agents in patients undergoing elective CABG, with good left ventricular systolic function produced comparable haemodynamic environment. Etomidate offers a faster rate of induction as compared to sevoflurane. No airway complications were found between two groups.

Keywords: *Haemodynamics, Sevoflurane, Etomidate, Coronary Artery Bypass.*

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I. INTRODUCTION

The primary objective of anaesthetic induction in cardiac surgery is to maintain haemodynamic stability, attenuate the stress response to intubation, and preserve myocardial oxygen balance [(1–3)]. Sevoflurane, a volatile agent with low blood–gas solubility, is non-irritant and has demonstrated cardioprotective effects against ischaemia–reperfusion injury during CABG [(4–6)]. However, few studies have evaluated its role as an induction agent compared with etomidate, and some have reported a high incidence of bradycardia (>50%) with sevoflurane induction in cardiac patients [(7–9)]. Etomidate, an imidazole derivative, is valued for its haemodynamic stability during induction, although concerns about adrenal suppression persist [(10–13)]. In elective cardiac surgery, such effects do not appear to influence vasopressor requirements or early outcomes [(14–16)]. Fentanyl,

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a commonly used opioid, offers additional haemodynamic stability [17].

This study compared sevoflurane and etomidate for induction in CABG patients with preserved LV function, focusing on hemodynamics, loss of consciousness, and airway complications.

II. METHODS

This prospective, randomized, single-blind trial was conducted in a tertiary cardiac surgery unit (January–December 2019) after ethics approval and informed consent. One hundred patients aged 35–75 years with coronary artery disease, normal sinus rhythm, and preserved left ventricular function (EF >50%) scheduled for elective CABG were enrolled. Patients with valvular disease, heart failure, sepsis, chronic steroid use, adrenal insufficiency, difficult airway, severe systemic or neurological disorders, combined CABG + valve surgery, or >2 intubation attempts were excluded. Randomization was performed by coin-flip: Group E received etomidate 0.2 mg/kg IV, and Group S received sevoflurane 4% inhalation until loss of eyelash reflex. Blinding was maintained for patients and intubating anaesthesiologists. All patients were premedicated with midazolam and fentanyl, intubated after rocuronium, and anaesthesia maintained with sevoflurane 2% in air : oxygen (1:1).

Haemodynamic variables (SBP, DBP, MAP, HR, CVP) were recorded at baseline, induction, and every minute for 5 minutes post-intubation. Airway events and intubation duration were noted. Hypotension (>30% fall from baseline) was managed with ephedrine or vasopressors, and bradycardia (HR <40/min) with atropine. Statistical analysis used t-test, chi-square, and Fisher's exact test; $p<0.05$ was considered significant.

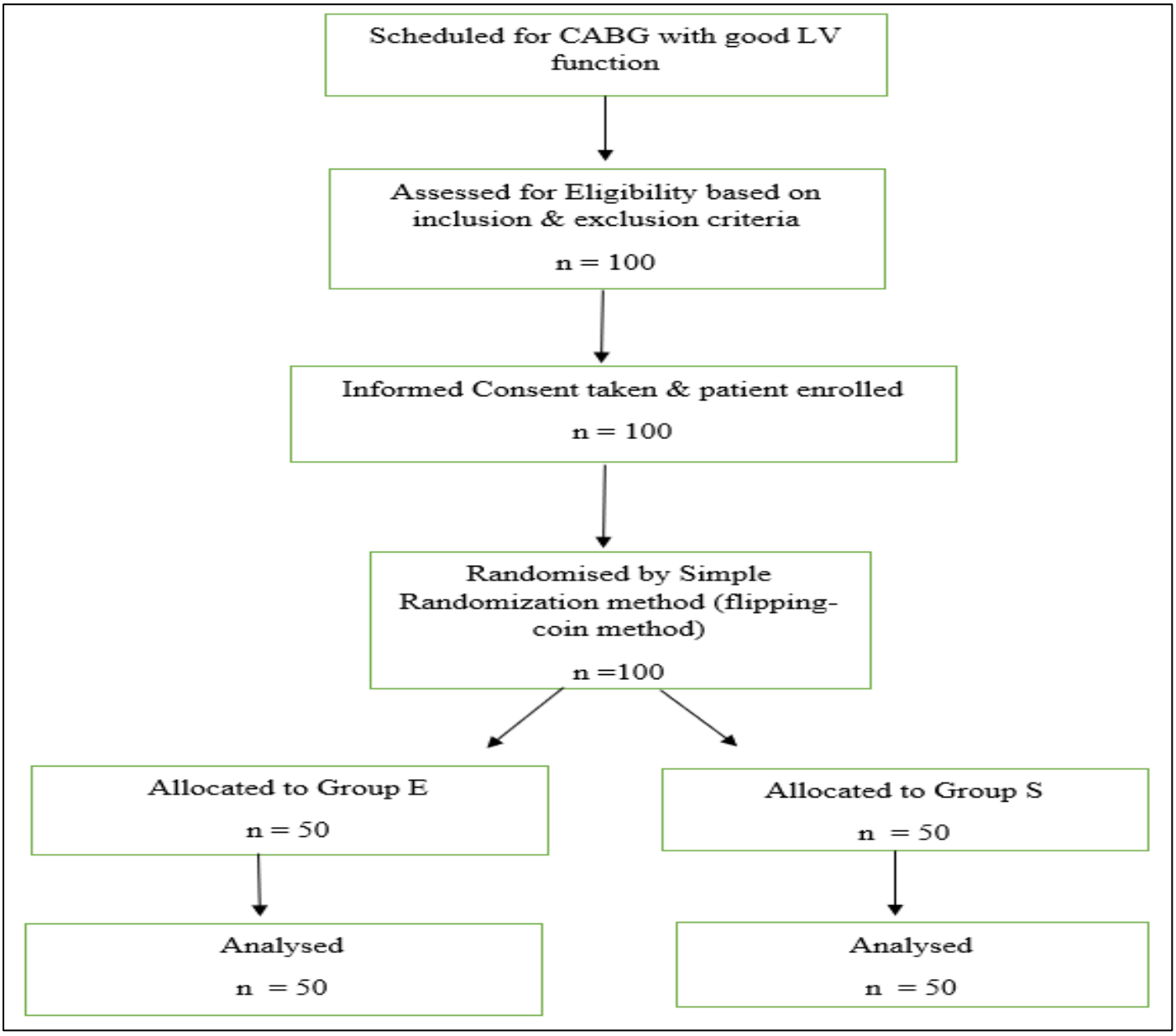

Fig 1 CONSORT Flow Diagram Depicting Patient Recruitment and Randomization.

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III. RESULTS

During the study, 110 patients were initially evaluated. Of these,7 patients were found to have anticipated difficult airway (on the basis of thyromental distance, mallampati score) and 3 patients had difficult laryngoscopy and tracheal intubation. Hence, they did not meet the inclusion criteria. 100 patients completed the present study and data from all these patients were analysed. The demographic profile of the two study groups were comparable with no statistically significant difference. Co morbidities, NYHA score, Thyromental distance and Mallampati score in Group E and Group S also did not vary significantly.

Table 1 Showing Baseline Hemodynamic Parameters (Pre Induction)

	Group E (n=50) mean ± SD	**Group S (n=50) mean ± SD**	**P Value**
Heart Rate (bpm)	63 ± 1.41	67.5 ± 3.53	0.7543
SBP (mmHg)	149.71 ± 26.11	152.66 ± 21.07	0.5889
DBP (mmHg)	77.80 ± 12.88	79.86 ± 10.34	0.4456
MBP (mmHg)	104.44 ± 18.09	105.34 ± 15.11	0.8133
SPO2 (%)	99.95 ± 0.22	99.83 ± 1.03	0.4527
CVP (mm Hg)	9.41 ± 4.09	9.51 ± 4.40	0.9177
LEAD II (mm)	-0.05 ± 0.30	0.03 ± 0.30	0.2279
LEAD V(mm)	-0.05 ± 0.23	-0.03 ± 0.22	0.7785

The baseline haemodynamic parameters and ST segment (mm) in lead II , lead V are comparable between Group E and Group S from Table no. 1.

Table 2 Showing Changes in SBP, DBP and MAP at Induction and Post Intubation

	Group E (n=50) mean ± sd	**Group S (n=50) mean ± sd**	**P Value**
SBP (mmHg)			
Induction	124.71 ± 26.82	121.26 ± 26.89	0.5732
1 minute post intubation	110.02 ± 26.07	101.80 ± 18.72	0.1195
2 minute post intubation	104.34 ± 23.49	99.66 ± 18.06	0.3331
3 minute post intubation	102.37 ± 18.37	100.54 ± 16.71	0.6501
4 minute post intubation	103.32 ± 17.83	102.57 ± 16.35	0.8488
5 minute post intubation	107.78 ± 18.00	104.20 ± 15.43	0.353
DBP (mmHg)			
Induction	68.78 ± 14.64	65.43 ± 13.41	0.2982
1 minute post intubation	63.66 ± 13.44	57.91 ± 12.02	0.05206
2 minute post intubation	59.39 ± 12.79	57.54 ± 11.85	0.5127
3 minute post intubation	58.39 ± 10.30	57.06 ± 11.39	0.5888
4 minute post intubation	59.10 ± 11.06	58.49 ± 10.80	0.8062
5 minute post intubation	62.54 ± 12.62	60.03 ± 11.68	0.3683
MBP (mmHg)			
Induction	88.29 ± 18.94	87.09 ± 20.27	0.7866
1 minute post intubation	77.59 ± 18.42	71.06 ± 15.05	0.09428
2 minute post intubation	73.24 ± 17.87	70.26 ± 13.91	0.4188
3 minute post intubation	71.71 ± 14.65	71.03 ± 12.55	0.8282
4 minute post intubation	72.73 ± 15.06	70.57 ± 11.44	0.4839
5 minute post intubation	75.51 ± 15.66	72.91 ± 11.57	0.4144

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Table 3 Showing changes in HR.

	Group E (n=50) mean ± sd	**Group S (n=50) mean ± sd**	**P Value**
Heart Rate (bpm)			
Induction	62.5 ± 3.53	64 ± 1.41	0.6211
1minutepost intubation	64.5 ± 2.12	76 ± 9.89	0.4900
2minutepost intubation	66.5 ± 4.94	74.5 ± 7.77	0.7762
3minutepost intubation	60.5 ± 4.94	69 ± 0.04	0.6143
4minutepost intubation	65.5 ± 4.94	72.5 ± 0.70	0.3544
5minutepost intubation	64 ± 9.89	76.5 ± 2.12	0.9290

From Table 2 and 3 there were no significant decrease in SBP, DBP, MAP and heart rate between the groups after induction and 1minute intervals till 5 minutes post intubation.

Table 4 Showing Changes in ST Segment in lead II and V

	GroupE (n=50) Mean ± SD	**GroupS (n=50) Mean ± SD**	**P Value**
LEAD II(mm)			
Induction	-0.10 ± 0.28	-0.03 ± 0.36	0.3364
1 minute post intubation	-0.13 ± 0.32	-0.08 ± 0.37	0.5079
2 minute post intubation	-0.15 ± 0.33	-0.10 ± 0.39	0.5238
3 minute post intubation	-0.14 ± 0.32	-0.12 ± 0.35	0.811
4 minute post intubation	-0.12 ± 0.31	-0.08 ± 0.30	0.5343
5 minute post intubation	-0.12 ± 0.31	-0.08 ± 0.31	0.4713
LEAD V(mm)			
Induction	-0.10 ± 0.23	-0.03 ± 0.25	0.136
1 minute post intubation	-0.13 ± 0.26	-0.08 ± 0.27	0.307
2 minute post intubation	-0.13 ± 0.30	-0.09 ± 0.30	0.4868
3 minute post intubation	-0.14 ± 0.30	-0.10 ± 0.27	0.5737
4 minute post intubation	-0.12 ± 0.29	-0.08 ± 0.23	0.4177
5 minute post intubation	-0.10 ± 0.28	-0.08 ± 0.24	0.6187

ST segment changes in LEAD II and LEAD V did not vary significantly at induction and till 5-minute post intubation.

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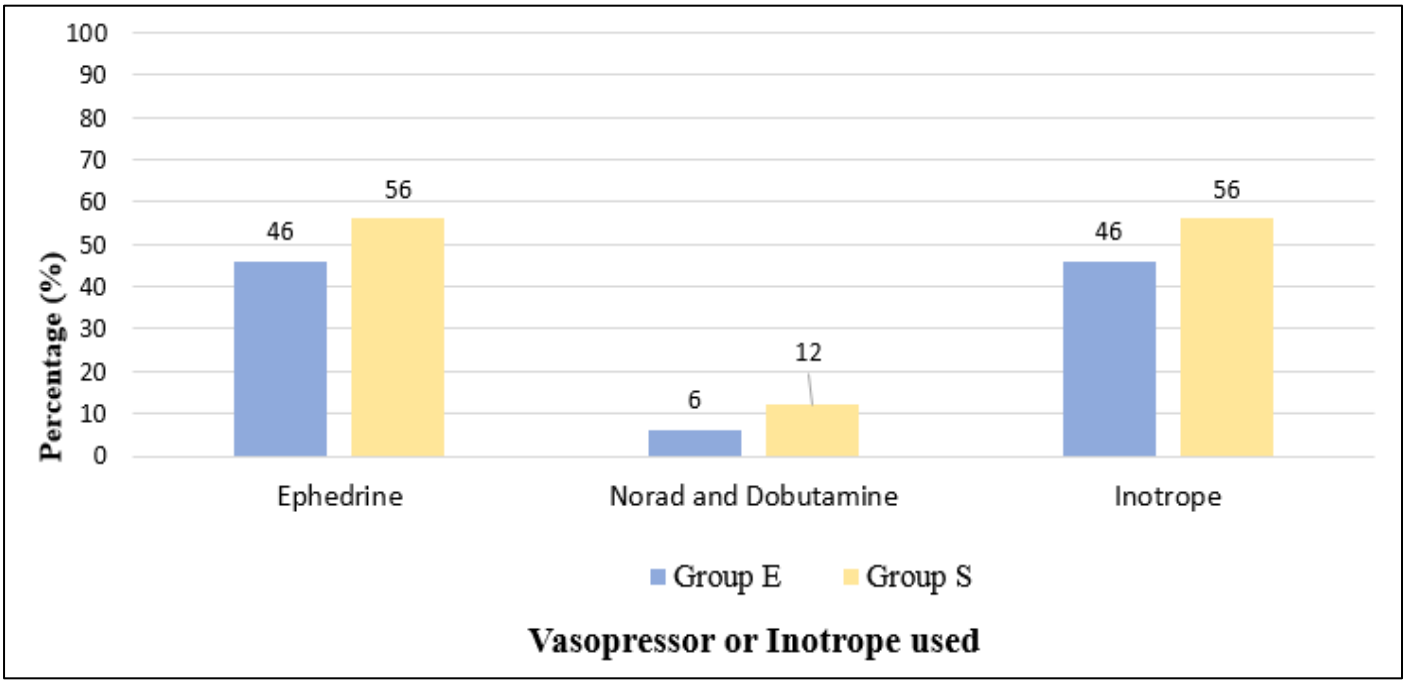

Fig 2 Shows Comparison of Vasopressor and Inotrope use Between Sevoflurane–Fentanyl Group (Group S) and Etomidate–Fentanyl Group (Group E) During Anaesthetic Induction for CABG Surgery.

The use of Inotrope/ Vasopressor did not vary significantly at induction and 1 minute interval till 5 minutes post intubation, however the use of vasopressor was slightly higher in Group S in comparison to Group E.

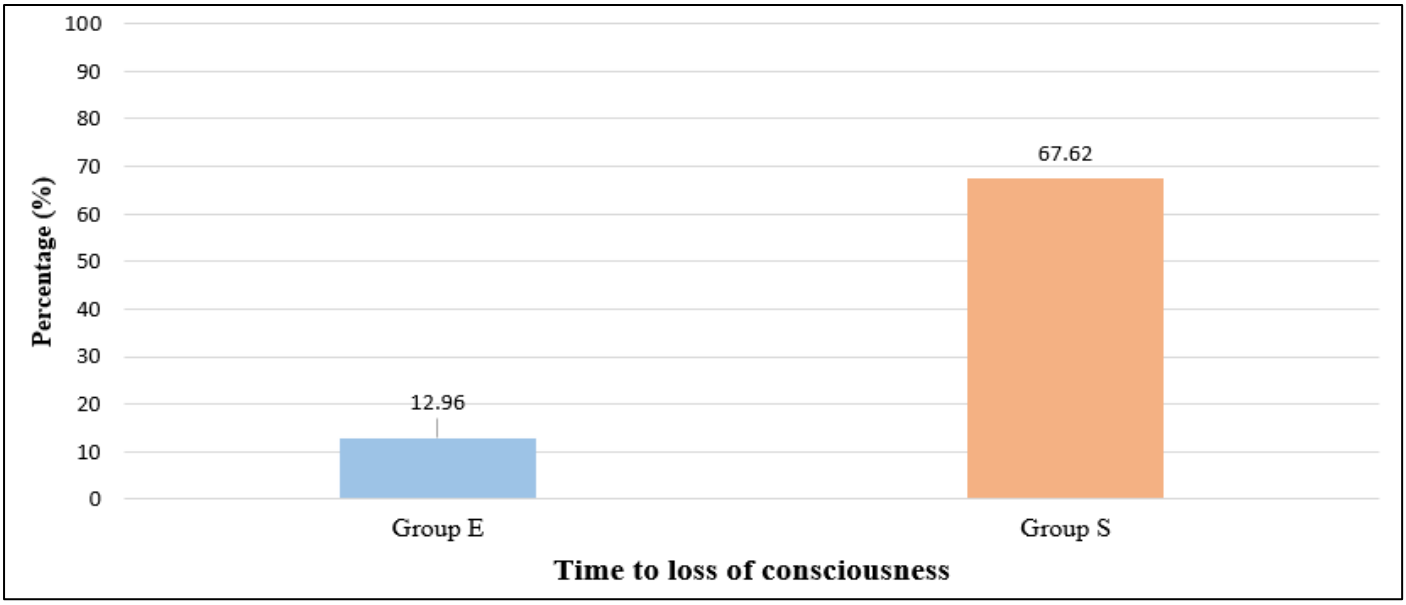

Fig 3 Comparison of Time to Loss of Consciousness Between Sevoflurane–Fentanyl Group (Group S) and Etomidate–Fentanyl Group (Group E) During Anaesthetic Induction for CABG Surgery.

Time till loss of consciousness (seconds) for Group S (67.62 ± 21.64) was significantly higher than that for Group E (12.96 ± 2.32) with P Value < 2.2e-16 < 0.05, test statistic used was t-test. Time for Laryngoscopy (sec) for Group E (10.04 ± 3.55) and Group S (11.26 ± 8.83) were similar between the groups (P value 0.3623).

Primary Outcome was that no significant changes in hemodynamic parameters were noted in both the groups. Secondary Outcome was that Induction of anaesthesia was significantly faster in patients with etomidate as compared to patients who received sevoflurane.

IV. DISCUSSION

The perioperative period in patients with coronary artery disease (CAD) undergoing surgery under general anaesthesia is associated with significant haemodynamic stress, predisposing them to myocardial ischaemia, infarction, or even perioperative mortality. Anaesthetic

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induction plays a pivotal role in influencing myocardial oxygen supply–demand balance, and the choice of agent can affect both intraoperative stability and postoperative outcomes. Tachycardia and hypertension during laryngoscopy and intubation are especially detrimental in patients with compromised left ventricular function. Hence, haemodynamic stability during induction is a critical determinant of safety in coronary artery bypass grafting (CABG).

In this study, etomidate provided rapid induction with stable hemodynamics, while sevoflurane induction using the tidal volume breath technique resulted in longer time to loss of consciousness but was equally safe, without airway complications. These findings echo earlier studies. Cheong et al. [18] demonstrated faster induction with etomidate compared to sevoflurane, while Singh et al. [19] reported induction times around 70 seconds with tidal volume breathing, comparable to our results. Both agents maintained cardiovascular stability, supporting their safety in cardiac surgical patients.

Haemodynamic variables, including systolic and diastolic blood pressure, mean arterial pressure, heart rate, and central venous pressure, did not differ significantly between groups at induction or during the five minutes post-intubation. Our results align with prior studies showing that etomidate and sevoflurane preserve haemodynamic parameters in cardiac and non-cardiac surgical patients [20–24]. Sukla et al. [24] specifically reported reduced haemodynamic variability with etomidate in off-pump CABG, while Hannam et al. [21] and Dai et al. [22] found minimal fluctuations when etomidate was used in high-risk cardiac populations.

The lack of difference in vasopressor or inotrope requirements between groups is also consistent with earlier findings. It is possible that the relatively high dose of fentanyl (10 µg/kg) and co-administration of midazolam in both groups contributed to the gradual reduction in vascular resistance and blood pressure observed, as supported by Skourtis et al. [25] and Jeon et al. [26].

Electrocardiographic monitoring showed no significant ST-segment deviations between groups. Etomidate has been previously shown not to exacerbate ischaemic changes [29], while sevoflurane has demonstrated cardioprotective effects with reduced troponin release in vascular surgery [30]. Thus, both agents appear safe from the perspective of myocardial ischaemia during induction.

In summary, this study confirms that etomidate offers faster induction with excellent haemodynamic stability, while sevoflurane provides comparable cardiovascular safety and the added benefit of myocardial protection. Both agents can therefore be considered suitable for induction in CABG patients with preserved ventricular function.

➢ *Novelty of the Study-*

Current cardiac anaesthesia practice gives attention to preservation of myocardial function and avoidance of myocardial ischaemia and reperfusion injury during Coronary Artery Bypass Grafting Surgery (CABG). Although intravenous induction of anaesthesia is generally favoured because of its speed and smoothness but induction with volatile agents may have the advantage of having minimal and rapidly reversible effects on peripheral vascular resistance and cardiac contractility. Therefore volatile induction and maintenance of anaesthesia is gaining popularity in cardiac anaesthesia, especially with introduction of low solubility and non-irritating volatile agents.

V. LIMITATION OF STUDY

Intra operation hemodynamic changes beyond 5minutes and postoperative hemodynamic changes and complications were not followed up. Since no depth of anaesthesia monitoring was applied, equivalence of the two anaesthetic techniques, particularly during induction could not be confirmed. Only good left ventricular function (ejection fraction greater than equal to 50%) patients were included in the study.

VI. CONCLUSION

- Hemodynamic parameters at induction and 5 minutes subsequently were comparable between the groups.
- Hence, sevoflurane is equally effective as etomidate in terms of hemodynamic stability.
- Time to loss of consciousness is shorter for etomidate in comparison to sevoflurane.
- No airway incidence was observed in both the groups.

- *Funding Sources*

✓ Nil.

- *Conflicts of Interest*

✓ The authors declare no conflicts of interest.

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