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RESEARCH ARTICLE
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HEMODYNAMIC STABILITY WITH ETOMIDATE VS PROPOFOL AS INDUCTION AGENTS IN CORONARY ARTERY BYPASS GRAFT SURGERY

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ABSTRACT

BACKGROUND

Maintaining hemodynamic stability during anesthetic induction is critical in patients undergoing CABG (Coronary Artery Bypass Graft) surgery due to their compromised cardiac function. Etomidate and propofol are commonly used induction agents, but they differ significantly in their cardiovascular effects**.**

AIM: The study aims to determine which induction agent minimises peri-induction cardiovascular fluctuations and maximises patient safety during anaesthesia induction by comparing the haemodynamic stability offered by etomidate and propofol in patients undergoing CABG surgery.

MATERIALS AND METHODS: This prospective study included 100 CABG patients randomized into two groups: etomidate (0.3 mg/kg, n=50) and propofol (2 mg/kg, n=50). MAP (Mean Arterial Pressure), HR (Heart Rate), hypotension incidence, and vasopressor use were assessed at baseline and post-induction.

RESULTS: Etomidate showed significantly better MAP stability at 1, 3, and 5 minutes post-induction ($p < 0.001$). Hypotension occurred in 6% of etomidate vs. 28% of propofol patients ($p = 0.003$). Vasopressors were needed in 4% vs. 22% respectively ($p = 0.006$). HR changes were not significant.

CONCLUSION

Etomidate provides superior hemodynamic stability compared to propofol and is preferred for induction in high-risk CABG patients.

KEYWORDS

Etomidate, Propofol, Hemodynamic Stability, Anesthetic Induction, Coronary Artery Bypass Graft, Cardiac Anesthesia, Mean Arterial Pressure, Vasopressor Use.

INTRODUCTION

One of the most common cardiac procedures to restore myocardial perfusion in patients with severe coronary obstruction is CABG (Coronary Artery Bypass Graft) surgery. CAD (Coronary Artery Disease) is still a major cause of morbidity and mortality globally. Perioperative management is

especially difficult for CABG patients because they are frequently elderly and have impaired cardiac function. Anaesthetic induction is one of the most important variables affecting the results of heart surgery, especially when it comes to preserving haemodynamic stability during this delicate time.Cardiovascular dynamics can be significantly impacted by anaesthetic induction agents, particularly in patients with low cardiac reserve. Myocardial ischaemia, arrhythmias, or cardiac arrest can be triggered by haemodynamic instability during induction, such as bradycardia or hypotension. Consequently, cardiovascular safety and efficacy must be balanced when selecting an induction agent. Two substances that are frequently used for intravenous induction of cardiac anaesthesia are etomidate and propofol. Their pharmacologic effects and haemodynamic profiles, however, vary greatly.

Etomidate is a hypnotic agent with a favourable haemodynamic profile that is derived from imidazoles. It is a preferred treatment for critically ill or haemodynamically unstable patients because it maintains systemic vascular resistance and causes little depression of myocardial contractility.[1] Furthermore, compared to many other agents, it has been demonstrated to maintain cardiovascular stability during induction more successfully. Its widespread use has been constrained, though, by worries about myoclonus and temporary adrenal suppression.[2]

Another popular induction agent is propofol, a phenol derivative, which is perfect for smooth induction and early recovery because of its quick onset and brief duration of action.[3] Propofol, however, is linked to severe dose-dependent cardiovascular depression. It lowers myocardial contractility and systemic vascular resistance, which frequently results in hypotension and can be harmful for patients having CABG surgery.[4]

Etomidate's and propofol's haemodynamic effects in a variety of surgical contexts, including heart surgery, have been compared in a number of studies. Propofol is still widely used because of its favourable pharmacokinetics and clinician familiarity, even though etomidate is frequently linked to improved haemodynamic stability. There is conflicting evidence regarding which agent is better in the particular setting of CABG surgery, which calls for more research.

This study intends to assess and compare the cardiovascular effects of propofol and etomidate, given the vital significance of preserving haemodynamic stability during anaesthetic induction in CABG patients. This study aims to determine the induction agent that provides the best safety and effectiveness in this high-risk patient population by examining metrics like heart rate, blood pressure, and the frequency of intraoperative hypotension.

MATERIALS AND METHODS

This prospective, observational study was conducted to compare the hemodynamic effects of etomidate and propofol as induction agents in patients undergoing elective CABG surgery. A total of 100 adult patients scheduled for isolated CABG procedures under general anesthesia were enrolled after obtaining institutional ethical committee approval and written informed consent. Patients were randomly allocated into two groups of 50 each using a computer-generated randomization table. Group E received intravenous etomidate at a dose of 0.3 mg/kg, while Group P received intravenous propofol at a dose of 2 mg/kg as the induction agent. Inclusion criteria included patients aged 40–75 years, of either sex, classified as ASA (American Society of Anesthesiologists) physical status II–III, and scheduled for elective CABG under cardiopulmonary bypass. Patients with significant valvular heart disease, emergency surgery, severe left ventricular dysfunction (ejection fraction <30%), known adrenal insufficiency, or allergy to study drugs were excluded. Standard monitoring including electrocardiogram, pulse oximetry, invasive arterial blood pressure, and central venous pressure was instituted for all patients. Baseline hemodynamic parameters were recorded before induction and at predefined intervals: immediately after induction and at 1, 3, and 5 minutes post-induction. The primary outcomes were changes in MAP (Mean Arterial Pressure) and HR (Heart Rate) from baseline. Secondary outcomes included incidence of hypotension (defined as a >20% fall in MAP from baseline), bradycardia (HR <50 bpm), and need for vasopressor support.

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using the independent samples t-test. Categorical variables were analyzed using the chi-square test. A p-value < 0.05 was considered statistically significant.

RESULT

A total of 100 patients undergoing elective CABG surgery were included in the study, with 50 patients each in Group E (etomidate) and Group P (propofol). The baseline demographic characteristics, such as age, sex, body weight, and ASA physical status were comparable between the two groups ($p > 0.05$). In terms of hemodynamic parameters, Group E demonstrated significantly better stability during induction. The MAP in the etomidate group showed minimal reduction from baseline, while the propofol group experienced a more pronounced decline. At 1 minute post-induction, MAP dropped by an average of 5.2% in Group E, compared to a 17.4% reduction in Group P ($p < 0.001$). Similarly, at 3 and 5 minutes post-induction, Group P continued to show significantly lower MAP values. Regarding heart rate, both groups exhibited a slight increase post-induction, but the change was not statistically significant between the two groups ($p > 0.05$). The incidence of hypotension was markedly higher in the propofol group (28%) compared to the etomidate group (6%), and vasopressor support was required in 22% of patients in Group P versus only 4% in Group E. These findings suggest that etomidate maintains superior hemodynamic stability compared to propofol during anesthetic induction in patients undergoing CABG surgery.

Parameter	Group E (Etomidate)	Group P (Propofol)	P-Value
Baseline MAP (mmHg)	92.4 ± 6.8	91.8 ± 7.1	0.64
MAP at 1 min post-induction	87.7 ± 6.5	75.8 ± 7.9	<0.001
MAP at 3 min post-induction	85.5 ± 6.9	73.4 ± 7.4	<0.001
MAP at 5 min post-induction	86.1 ± 6.7	74.2 ± 6.8	<0.001
Baseline HR (bpm)	78.6 ± 8.3	77.9 ± 7.5	0.69
HR at 1 min post-induction	80.1 ± 7.9	82.4 ± 8.1	0.21
HR at 3 min post-induction	81.3 ± 8.0	84.5 ± 8.4	0.07
Hypotension Incidence (%)	6%	28%	0.003
Vasopressor Use (%)	4%	22%	0.006

Table 1: Comparison of Hemodynamic Parameters between Etomidate and Propofol Groups

DISCUSSION

This study's findings show that when patients are having CABG surgery, etomidate offers better haemodynamic stability than propofol when it comes to inducing anaesthesia. These results support the clinical usefulness of etomidate in high-risk cardiac patients and are in line with earlier research.

Myocardial oxygen balance can be greatly impacted by haemodynamic instability during anaesthesia induction, especially in patients with impaired coronary perfusion. Despite being widely used because of its quick onset and good recovery profile, propofol is known to reduce myocardial contractility and systemic vascular resistance in a dose-dependent manner, which can lead to hypotension.[5] Similar to Tekwani et al.'s findings, who also noted higher hypotension with propofol in ED patients,[6] patients in the propofol group in this study had a significantly higher drop in MAP post-induction than those in the etomidate group.

In contrast, etomidate is a better induction agent for patients with a low cardiac reserve because it better maintains cardiovascular parameters. Etomidate kept MAP in the current study between 5 and 7% of baseline values for the duration of the post-induction phase. Etomidate's distinct pharmacologic profile, which includes negligible effects on sympathetic tone and baroreceptor reflexes, is responsible for this stability.[7] Similar results were reported by Hildreth et al., who observed that in patients undergoing major vascular surgery, etomidate caused fewer haemodynamic fluctuations than propofol.[8]

Propofol's strong vasodilatory effect is a major worry, particularly for elderly and heart-compromised patients. Propofol has been shown in studies to decrease both preload and afterload and to have a dose-dependent effect on cardiac output.[9] In our study, these effects were clearly visible, as 28% of patients in the propofol group required vasopressors due to hypotension, while only 6% of patients in the etomidate group did the same. Larsen et al.'s findings, which emphasised the harmful

haemodynamic effects of propofol in elderly populations with diminished cardiovascular reserve, are consistent with this.[10]

In our study, there was no discernible difference in the two groups' heart rate responses. Both propofol and etomidate caused a modest, non-significant rise in heart rate after induction, indicating that MAP is more sensitive than HR at identifying early cardiovascular compromise during induction. Prior research on HR has shown conflicting findings; some have shown reflex tachycardia with etomidate, while others have shown bradycardia after propofol.[11,12]

Etomidate's potential to inhibit adrenocortical function is another issue that is frequently brought up. After a single induction dose, this effect is usually temporary and clinically insignificant, despite the fact that it is well-documented, especially with repeated doses or continuous infusions.[13] According to a meta-analysis by Komatsu et al., if adrenal suppression is properly monitored and controlled, a single dose of etomidate does not increase morbidity or mortality in patients undergoing heart surgery.[14]

Crucially, even though etomidate seems to have better haemodynamic stability, other considerations like patient comorbidities, the possibility of adrenal suppression, and the anesthesiologist's familiarity with the medication must also be taken into account when selecting an induction agent. In some non-cardiac situations, propofol may be advantageous due to its easier induction and decreased risk of myoclonus. Etomidate, however, is unquestionably the more haemodynamically advantageous choice in the context of CABG surgery, where preserving coronary perfusion pressure is crucial. In summary, this study's findings support the body of research showing that etomidate provides superior cardiovascular stability to propofol when anaesthesia is induced in CABG patients. These results support the preferential use of etomidate in patients who are at high risk for heart attacks, especially those who have severe coronary disease or a low ejection fraction.

CONCLUSION

In patients undergoing CABG surgery, the choice of induction agent significantly influences peri-induction hemodynamic stability-a critical factor in reducing myocardial stress and improving surgical outcomes. This study demonstrates that etomidate offers superior cardiovascular stability compared to propofol during the induction of general anesthesia. Etomidate was associated with a significantly smaller decrease in mean arterial pressure, a lower incidence of hypotension, and reduced need for vasopressor support. While propofol remains widely used for its rapid onset and favorable recovery characteristics, its propensity to cause significant hypotension may pose a risk in patients with compromised cardiac function. Etomidate’s minimal cardiovascular depressant effects make it a more suitable choice for patients with poor cardiac reserve, such as those undergoing CABG surgery. Despite concerns about transient adrenal suppression with etomidate, current evidence suggests that a single induction dose is unlikely to result in clinically significant endocrine dysfunction. Therefore, in high-risk cardiac patients, particularly those with reduced left ventricular function or unstable hemodynamics, etomidate should be considered the induction agent of choice. Further large-scale, randomized controlled trials are recommended to validate these findings and explore long-term outcomes, including the impact on ICU stay, recovery time, and mortality.

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