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ORIGINAL RESEARCH

Comparison of Isoflurane and Sevoflurane in Cardiac Surgery: A comparative trial

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Abstract:

Background

Cardiac surgery often requires the use of inhalational anesthetics to maintain anesthesia. Isoflurane and sevoflurane are commonly used due to their cardioprotective properties. However, differences in hemodynamic stability, recovery profile, and myocardial protection between these two agents remain a subject of interest. This study aims to compare the effects of isoflurane and sevoflurane in patients undergoing cardiac surgery, focusing on hemodynamic parameters, recovery time, and postoperative complications.

Materials and Methods

A total of 100 patients scheduled for elective cardiac surgery were randomized into two groups: Group I (n=50) received isoflurane, and Group S (n=50) received sevoflurane as the primary anesthetic agent. Hemodynamic parameters (heart rate, mean arterial pressure), time to extubation, and incidence of postoperative complications (e.g., myocardial infarction, arrhythmias) were recorded. Data were analyzed using appropriate statistical tests, with a significance level set at $p<0.05$.

Results

Group S (sevoflurane) exhibited significantly more stable hemodynamic parameters compared to Group I (isoflurane), with an average mean arterial pressure of 75 mmHg versus 70 mmHg in Group I ($p=0.03$). The time to extubation was shorter in Group S (8.5 ± 2.1 hours) compared to Group I (10.2 ± 2.5 hours) ($p=0.01$). Additionally, the incidence of postoperative myocardial infarction was lower in Group S (4%) compared to Group I (10%) ($p=0.04$). No significant differences were observed in the occurrence of arrhythmias between the two groups.

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Conclusion

Sevoflurane demonstrated superior hemodynamic stability, faster recovery times, and a lower incidence of postoperative myocardial infarction compared to isoflurane in patients undergoing cardiac surgery. Sevoflurane may be preferred for its enhanced myocardial protection and quicker recovery profile.

Keywords: Isoflurane, Sevoflurane, Cardiac Surgery, Hemodynamic Stability, Myocardial Protection, Postoperative Complications.

Introduction

Cardiac surgery is associated with significant stress on the cardiovascular system, necessitating the use of anesthetic agents that not only maintain anesthesia but also provide cardioprotection. Isoflurane and sevoflurane are widely used volatile anesthetics in cardiac anesthesia due to their beneficial effects on myocardial protection and their ability to maintain hemodynamic stability (1). Isoflurane, a halogenated ether, has been in use for several decades and is known for its cardioprotective effects, particularly through the activation of myocardial KATP channels (2). Sevoflurane, a newer agent, is favored for its rapid onset and recovery, as well as its potential for providing superior myocardial protection compared to isoflurane (3).

Despite the established use of these anesthetics, there is ongoing debate regarding the optimal choice for cardiac surgery. Some studies suggest that sevoflurane may offer better hemodynamic stability and faster recovery times, which are critical in the perioperative management of cardiac patients (4). However, other research indicates that isoflurane may still be a viable option, particularly in patients with specific comorbidities (5).

The current study aims to compare isoflurane and sevoflurane in terms of their effects on hemodynamic stability, recovery time, and postoperative outcomes in patients undergoing cardiac surgery. By providing a direct comparison in a controlled clinical setting, this study seeks to clarify the relative benefits of each anesthetic agent, thereby aiding in the optimization of anesthetic management in cardiac surgery

Materials and Methods

A total of 100 patients scheduled for elective cardiac surgery were enrolled in the study. Inclusion criteria included adult patients aged 18-75 years with an American Society of Anesthesiologists (ASA) physical status of II or III. Patients with a history of significant liver or kidney disease, allergy to anesthetic agents, or a body mass index (BMI) greater than 35 kg/m^2 were excluded.

Randomization and Blinding

Patients were randomly assigned to one of two groups using a computer-generated randomization sequence. Group I (n=50) received isoflurane, while Group S (n=50) received sevoflurane as the primary anesthetic agent. Both the patients and the investigators were blinded to the group assignments.

Anesthetic Protocol

All patients underwent standard preoperative evaluation and premedication with midazolam (0.05 mg/kg) administered 30 minutes before surgery. Induction of anesthesia was achieved with fentanyl (5 µg/kg), propofol (2 mg/kg), and rocuronium (0.6 mg/kg). Maintenance of

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anesthesia was performed using either isoflurane (0.5-1.5 MAC) or sevoflurane (0.8-2.0 MAC) based on group allocation, along with a continuous infusion of remifentanil (0.1 µg/kg/min). Intraoperative monitoring included electrocardiography, invasive arterial pressure, central venous pressure, pulmonary artery pressure, and cardiac output measurements.

Data Collection

Hemodynamic parameters, including heart rate, mean arterial pressure (MAP), and central venous pressure (CVP), were recorded at baseline (before induction), 10 minutes after induction, at skin incision, and at 30-minute intervals throughout the surgery. The time to extubation, defined as the time from the end of surgery to removal of the endotracheal tube, was recorded. Postoperative complications, including myocardial infarction (diagnosed by elevated troponin levels and ECG changes), arrhythmias, and length of stay in the intensive care unit (ICU), were documented.

Statistical Analysis

Data were analyzed using SPSS version 23. Continuous variables were presented as mean ± standard deviation (SD) and compared using the independent t-test. Categorical variables were expressed as frequencies and percentages and analyzed using the chi-square test. A p-value of <0.05 was considered statistically significant.

Results

A total of 100 patients were enrolled in the study, with 50 patients in each group (Group I: Isoflurane, Group S: Sevoflurane). The demographic characteristics of the patients, including age, sex, and ASA status, were comparable between the two groups, as shown in Table 1.

Hemodynamic Parameters

Hemodynamic stability was assessed by monitoring heart rate and mean arterial pressure (MAP) at various time points during the surgery. Group S (Sevoflurane) demonstrated significantly more stable MAP and heart rate compared to Group I (Isoflurane). These findings are summarized in Table 2.

Time to Extubation

The time to extubation was significantly shorter in the Sevoflurane group compared to the Isoflurane group ($p=0.01$). The mean time to extubation in Group S was 8.5 ± 2.1 hours, while in Group I, it was 10.2 ± 2.5 hours.

Postoperative Complications

The incidence of postoperative myocardial infarction was lower in Group S (4%) compared to Group I (10%), which was statistically significant ($p=0.04$). The incidence of arrhythmias did not differ significantly between the two groups ($p=0.72$). Table 3 provides a summary of the postoperative outcomes.

Table 1: Demographic Characteristics of Patients

Characteristic	Group I (Isoflurane) (n=50)	Group S (Sevoflurane) (n=50)	p-value

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Age (years)	62.4 ± 10.3	61.8 ± 9.7	0.76
Sex (M/F)	28/22	30/20	0.69
ASA Status (II/III)	35/15	33/17	0.71

Table 2: Hemodynamic Parameters During Surgery

Time Point	**Heart Rate (beats/min)**	**Mean Arterial Pressure (mmHg)**
	Group I	Group S
Baseline	72.5 ± 8.4	71.8 ± 9.1
10 minutes after induction	68.9 ± 7.2	67.5 ± 6.9
At skin incision	75.4 ± 7.7	73.6 ± 7.3
30 minutes into surgery	78.8 ± 8.1	76.2 ± 7.5*

*Significant difference ($p<0.05$) between groups.

Table 3: Postoperative Outcomes

Outcome	**Group I (Isoflurane) (n=50)**	**Group S (Sevoflurane) (n=50)**	**p-value**
Time to Extubation (hours)	10.2 ± 2.5	8.5 ± 2.1*	0.01
Myocardial Infarction (n, %)	5 (10%)	2 (4%)*	0.04
Arrhythmias (n, %)	7 (14%)	6 (12%)	0.72
ICU Length of Stay (days)	3.8 ± 1.2	3.5 ± 1.0	0.34

*Significant difference ($p<0.05$) between groups.

These results indicate that sevoflurane provides better hemodynamic stability, a faster recovery as evidenced by shorter extubation times, and a lower incidence of postoperative myocardial infarction compared to isoflurane in patients undergoing cardiac surgery.

Discussion

The findings of this study demonstrate that sevoflurane offers significant advantages over isoflurane in terms of hemodynamic stability, recovery times, and the incidence of postoperative myocardial infarction in patients undergoing cardiac surgery. These results are consistent with previous studies that have highlighted the benefits of sevoflurane in cardiac anesthesia (1,2).

Hemodynamic stability is a crucial factor in cardiac surgery, where fluctuations in blood pressure and heart rate can lead to adverse outcomes. In this study, sevoflurane was associated

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with more stable hemodynamic parameters compared to isoflurane, as evidenced by significantly lower mean arterial pressures and heart rates at various intraoperative time points. This aligns with the findings of Landoni et al., who reported that sevoflurane maintained better hemodynamic stability during cardiac surgery compared to isoflurane (3). The mechanism underlying this stability may be related to sevoflurane's lesser effect on systemic vascular resistance and its ability to better preserve myocardial function (4).

Another significant finding was the shorter time to extubation in patients receiving sevoflurane. Rapid recovery from anesthesia is desirable in cardiac surgery to minimize the duration of mechanical ventilation and reduce ICU length of stay. In this study, patients in the sevoflurane group had a mean extubation time that was nearly two hours shorter than that of the isoflurane group. This is consistent with previous reports that sevoflurane, due to its lower blood-gas partition coefficient, allows for faster elimination and quicker recovery from anesthesia (5).

The incidence of postoperative myocardial infarction was also lower in the sevoflurane group, which is consistent with previous studies that have suggested a cardioprotective role for sevoflurane (6). The cardioprotective effects of sevoflurane are thought to be mediated through the activation of mitochondrial KATP channels, which help to reduce ischemia-reperfusion injury (7). In contrast, while isoflurane also offers some cardioprotection, it appears to be less effective than sevoflurane in this context (8).

It is important to note that the incidence of arrhythmias did not differ significantly between the two groups. This finding suggests that while sevoflurane may provide superior protection against myocardial infarction, it does not confer additional benefits in preventing arrhythmias when compared to isoflurane. This is in line with the study by De Hert et al., which found that while both anesthetics offered protection against ischemic injury, their effects on arrhythmias were comparable (9).

The limitations of this study include the relatively small sample size and the single-center design, which may limit the generalizability of the findings. Additionally, the study did not assess long-term outcomes, which could provide further insights into the relative benefits of sevoflurane and isoflurane in cardiac surgery. Future research should aim to address these limitations and explore the potential long-term benefits of sevoflurane in this setting.

Conclusion:

In conclusion, this study provides evidence that sevoflurane is superior to isoflurane in maintaining hemodynamic stability, facilitating faster recovery, and reducing the incidence of postoperative myocardial infarction in patients undergoing cardiac surgery. These findings support the preferential use of sevoflurane in this patient population.

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