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Effect of Sevoflurane Inhalation Anesthesia on Hemodynamics and Recovery Profile in Elective Laparoscopic Cholecystectomy

[1]Dr. Samruddha M. Patil, Senior Resident, Nandi Medical College and Research Institute, Chikkaballapura, Karnataka, India.

[2]Dr. Suman S, MBBS, MD, Consultant, Department of Anesthesiology and Critical Care, Aster CMI Hospital, Bangalore, India

[3]Dr. Sumangala Mulagund, Senior Resident, Department of Anaesthesiology, Yadgir Institute of Medical Sciences YIMS, Yadgir, Karnataka, India.

Corresponding Author: Dr. Samruddha M. Patil, Senior Resident, Nandi Medical College and Research Institute, Chikkaballapura, Karnataka, India.

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Abstract

Background: Sevoflurane is a widely used inhalational anaesthetic agent that provides rapid induction, good hemodynamic stability, and smooth recovery. It is commonly used for elective laparoscopic cholecystectomy because of its favorable pharmacological profile.

Aim: To evaluate the effect of Sevoflurane inhalational anaesthesia on Intraoperative Hemodynamics and postoperative recovery profile in patients undergoing elective laparoscopic cholecystectomy.

Materials and Methods: This prospective study included 50 ASA physical status I and II patients aged 21–70 years undergoing elective laparoscopic cholecystectomy. Anaesthesia was induced with intravenous propofol (2 mg/kg) and atracurium (0.5 mg/kg), and maintained with sevoflurane (MAC 0.8–1.2) while maintaining a Bispectral Index (BIS) of 40–60. Hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), oxygen saturation (SpO_2), and BIS, were recorded at predefined intervals. Recovery profile was assessed using extubation time, post-anaesthesia care unit (PACU) stay, time to discharge, Modified Aldrete Score (MASS), White Fast-Tracking Scoring System (WFTSS), and the incidence of postoperative nausea and vomiting (PONV).

Results: Hemodynamic parameters remained stable throughout the Intraoperative period with only transient changes following intubation and extubation. Oxygen saturation was maintained at 100% during surgery, and BIS values remained within the target range. The mean extubation time was 11.24 ± 3.90 minutes, mean PACU stay was 14.80 ± 6.70 minutes, and mean time to discharge was 26.04 ± 8.70 minutes. The incidence of PONV was 2%, and satisfactory recovery scores were achieved in the majority of patients.

Conclusion: Sevoflurane inhalational anaesthesia provided satisfactory hemodynamic stability, smooth recovery, and a low incidence of postoperative nausea and vomiting in patients undergoing elective laparoscopic cholecystectomy, making it a safe and effective anaesthetic technique.

Keywords: Sevoflurane, Inhalational Anaesthesia, Laparoscopic Cholecystectomy, Hemodynamics, Recovery Profile, Bispectral Index, Modified Aldrete Score.

Introduction

Laparoscopic cholecystectomy is the gold standard surgical treatment for symptomatic gallstone disease due to its advantages of reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes compared with open cholecystectomy. However, the creation of pneumoperitoneum and patient positioning during laparoscopic surgery produce significant cardiovascular and respiratory changes, making the choice of anaesthetic technique an important determinant of perioperative outcomes.[1]

Sevoflurane is a modern volatile inhalational anaesthetic agent characterized by rapid induction and emergence because of its low blood-gas partition coefficient. It provides excellent control over the depth of anaesthesia and has become one of the most commonly used inhalational agents for laparoscopic procedures. Sevoflurane is associated with smooth induction, good hemodynamic control, and rapid postoperative recovery, making it suitable for ambulatory and minimally invasive surgeries.[2]

During laparoscopic cholecystectomy, pneumoperitoneum increases intra-abdominal pressure, resulting in sympathetic stimulation, increased systemic vascular resistance, and fluctuations in heart rate and blood pressure. Adequate anaesthetic depth is therefore essential to minimize these responses and maintain cardiovascular stability. Monitoring the depth of anaesthesia using the Bispectral Index (BIS) allows optimal titration of Sevoflurane concentration while avoiding both under- and over-anaesthesia. [3]

Postoperative recovery is another important consideration in modern anaesthetic practice. Early extubation, rapid recovery of consciousness, shorter stay in the post-anaesthesia care unit (PACU), and a low incidence of postoperative nausea and vomiting (PONV) contribute significantly to enhanced recovery protocols and improved patient satisfaction. Sevoflurane has demonstrated favorable recovery characteristics owing to its rapid elimination and ease of titration.[4]

The present study was undertaken to evaluate the effect of Sevoflurane inhalational anaesthesia on intraoperative hemodynamic parameters and postoperative recovery profile in patients undergoing elective laparoscopic cholecystectomy.

Materials and Methods

Study Site

Department of Anaesthesiology, Aster CMI Hospital, Bengaluru, Karnataka.

Study Population

ASA physical status I and II patients aged 21–70 years undergoing elective laparoscopic cholecystectomy.

Study Design

Prospective randomized clinical trial.

Sample Size

50 patients in Sevoflurane group.

Study Duration

One year.

Inclusion Criteria

- ASA I–II patients
- Age 21–70 years
- Elective laparoscopic cholecystectomy
- Written informed consent

Exclusion Criteria

- ASA III and above
- Emergency surgery
- BMI >35 kg/m²
- Sevoflurane allergy
- PONV history
- Age <21 or >70 years
- Patient refusal
- Coincidental surgeries

Anaesthesia Protocol (Sevoflurane Group)

- Premedication: Midazolam 1 mg, Fentanyl 100 µg, Glycopyrrolate 0.2 mg IV
- Preoxygenation: 100% oxygen for 3 minutes
- Induction: Propofol 2 mg/kg + Atracurium 0.5 mg/kg
- Maintenance: Sevoflurane (MAC 0.8–1.2) in oxygen–air mixture
- BIS target: 40–60
- Ventilation: $EtCO_2$ maintained at 30–35 mmHg
- Additional atracurium given as required
- Multimodal analgesia: Paracetamol 1 g, Morphine 0.05–0.1 mg/kg
- TAP block + Rectus sheath block with 0.2% Ropivacaine
- Antiemetic: Ondansetron 4 mg IV
- Reversal: Neostigmine + Glycopyrrolate
- Extubation after standard criteria

Outcome Measures

Primary Outcomes

- Extubation time
- Time in PACU (tpacu)
- Time to discharge (tdisc)
- Modified Aldrete Score (MASS)
- White Fast Tracking Score (WFTSS)

Secondary Outcomes

- Hemodynamic changes (HR, SBP, DBP, SpO_2, BIS)
- Incidence of PONV
- Adverse events
- Fast-tracking eligibility
- Anaesthetic recovery profile

Statistical Analysis

The collected data were entered into Microsoft Excel and analysed using SPSS software (version 21). Data were checked for completeness and normality prior to analysis.

Continuous variables such as age, height, weight, BMI, hemodynamic parameters, and recovery times were expressed as Mean ± Standard Deviation (SD). Categorical variables such as gender, ASA grade, and incidence of PONV were expressed as frequency and percentage.

For intergroup comparison, Independent Student's t-test was used for continuous variables. Chi-square test was applied for categorical variables. Repeated Measures Analysis of Variance (ANOVA) was used to assess

changes in hemodynamic parameters over different time intervals within and between groups. A p-value < 0.05 was considered statistically statistically significant.

Results And Observations

Table 1: Demographic Characteristics (Sevoflurane Group, n=50)

Variable	Mean ± SD
Age (years)	42.44 ± 11.30
Height (cm)	159.84 ± 9.76
Weight (kg)	68.48 ± 11.55
BMI (kg/m²)	26.80 ± 3.05
Duration of surgery (min)	103.48 ± 18.30

Table 2: Age Distribution

Age Group (years)	Frequency	Percentage (%)
20–30	11	22
31–40	21	42
41–50	5	10
51–60	8	16
61–70	5	10
Total	50	100

Table 3: Gender Distribution

Gender	Frequency	Percentage (%)
Male	15	30
Female	35	70
Total	50	100

Table 4: ASA Physical Status

ASA Grade	Frequency	Percentage (%)
ASA I	30	60
ASA II	20	40
Total	50	100

Table 5: Baseline Hemodynamic Parameters

Parameter	Mean ± SD
Heart Rate (beats/min)	85.04 ± 9.10
SBP (mmHg)	125.80 ± 11.40
DBP (mmHg)	80.40 ± 6.90
SpO_2 (%)	97.94 ± 1.03
BIS Score	95.80 ± 1.20

Table 6: Heart Rate Changes

Time Point	Mean ± SD
Post induction	80.54 ± 8.83
Post intubation	85.80 ± 11.57
15 min	81.56 ± 9.10
30 min	80.16 ± 6.78
1 hour	83.14 ± 6.98
Extubation	88.12 ± 6.21

Table 7: Blood Pressure Changes SBP

Time Point	Mean ± SD
Post induction	111.92 ± 7.17
Post intubation	120.40 ± 9.06
15 min	113.44 ± 7.27
30 min	114.88 ± 8.28
1 hour	117.00 ± 8.43
Extubation	127.32 ± 5.76

DBP

Time Point	Mean ± SD
Post induction	75.08 ± 6.18
Post intubation	79.88 ± 6.95
15 min	75.16 ± 5.48
30 min	77.08 ± 6.05
1 hour	77.16 ± 5.22
Extubation	80.64 ± 5.76

Table 8: Oxygen Saturation

Time Point	SpO_2 (%)
All Intraoperative points	100% maintained

Table 9: BIS Values

Time Point	Mean ± SD
Post induction	45.62 ± 3.05
Post intubation	45.60 ± 4.21

15 min	44.74 ± 3.98
30 min	46.00 ± 4.00
1 hour	46.28 ± 3.12
Extubation	84.82 ± 2.67

Table 10: Recovery Profile

Parameter	Mean ± SD
Extubation time (min)	11.24 ± 3.90
PACU stay (min)	14.80 ± 6.70
Time to discharge (min)	26.04 ± 8.70

Table 11: Postoperative Nausea and Vomiting

Outcome	Frequency	Percentage
No PONV	49	98%
PONV	1	2%

Table 12: Fast Tracking (WFTSS ≥12)

Outcome	Frequency	Percentage
Yes	2	4%
No	48	96%

Table 13: Modified Aldrete Score at Extubation

Score	Frequency	Percentage
6	6	12%
7	34	68%
8	10	20%
9	0	0%

Discussion

The present study evaluated the effect of Sevoflurane inhalational anaesthesia on Intraoperative hemodynamic stability and postoperative recovery in 50 patients undergoing elective laparoscopic cholecystectomy.

The demographic characteristics of the study population were comparable with those reported in previous studies. The mean age was 42.44 ± 11.30 years, and females constituted 70% of the study population, reflecting the higher prevalence of gallstone disease among women. Most patients belonged to ASA physical status I (60%), indicating that the majority were healthy individuals undergoing elective surgery.

Baseline hemodynamic parameters, including heart rate, systolic blood pressure, diastolic blood pressure, oxygen saturation, and BIS values, were within normal physiological limits before induction of anaesthesia. During surgery, a mild decrease in heart rate and blood pressure was observed after induction, followed by a transient increase after tracheal intubation and extubation. These changes are consistent with the sympathetic response associated with airway manipulation and pneumoperitoneum. Nevertheless, the hemodynamic variables remained within acceptable clinical limits throughout the procedure, suggesting that Sevoflurane provided satisfactory cardiovascular stability. Similar observations have been reported by Joris et al., who demonstrated acceptable hemodynamic control with volatile anaesthetic agents during laparoscopic surgery.[5]

Oxygen saturation remained at 100% throughout the Intraoperative period, indicating adequate ventilation and oxygenation. BIS values were maintained between 40 and 60 during maintenance of anaesthesia, confirming adequate anaesthetic depth and appropriate titration of Sevoflurane. Gan et al. reported that BIS-guided anaesthesia improves Intraoperative anaesthetic management and facilitates smooth recovery.[6]

The recovery profile observed in this study was satisfactory. The mean extubation time was 11.24 ± 3.90 minutes, the mean PACU stay was 14.80 ± 6.70 minutes, and the mean time to discharge from PACU was 26.04 ± 8.70 minutes. These findings indicate that Sevoflurane allows predictable emergence from anaesthesia and acceptable postoperative recovery. Similar recovery characteristics have been described in previous studies

evaluating volatile anaesthetic agents in laparoscopic surgery.[7]

Postoperative nausea and vomiting occurred in only one patient (2%), indicating a low incidence of PONV. Although volatile anaesthetic agents are generally associated with a higher incidence of PONV than total intravenous anaesthesia, routine administration of ondansetron and multimodal analgesia in the present study likely contributed to the reduced occurrence of postoperative nausea and vomiting. [8]

At extubation, the majority of patients achieved a Modified Aldrete Score of 7 (68%) or 8 (20%), indicating satisfactory recovery immediately after anaesthesia. However, only 4% of patients fulfilled the White Fast-Tracking criteria within five minutes after extubation, suggesting that although recovery was smooth, immediate fast tracking was achieved in relatively few patients.

Overall, the findings of the present study demonstrate that Sevoflurane inhalational anaesthesia provides effective Intraoperative hemodynamic stability, adequate depth of anaesthesia, satisfactory postoperative recovery, and a low incidence of postoperative nausea and vomiting in patients undergoing elective laparoscopic cholecystectomy.

The main limitation of this study is the relatively small sample size and inclusion of only ASA I and II patients, which may limit the generalizability of the findings. Further multicentre studies involving larger patient populations are recommended to confirm these observations.

Conclusion

Sevoflurane inhalational anaesthesia provided satisfactory Intraoperative hemodynamic stability and an acceptable postoperative recovery profile in patients undergoing elective laparoscopic cholecystectomy. It was associated with stable vital parameters, smooth emergence from anaesthesia, low incidence of postoperative nausea and vomiting, and good recovery scores, making it a safe and effective anaesthetic technique for elective laparoscopic cholecystectomy.

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