



Effect of Propofol, Sevoflurane and Isoflurane on Postoperative Cognitive Function Following Laparoscopic Cholecystectomy in Elderly Patients

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Abstract: Background: Postoperative cognitive dysfunction (POCD) is a common and clinically significant complication in elderly patients following surgery and anesthesia. The choice of anesthetic agent may influence the incidence and severity of POCD. This study aimed to compare the effects of propofol, sevoflurane, and isoflurane on postoperative cognitive function in elderly patients undergoing laparoscopic cholecystectomy. **Materials and Methods:** This prospective, randomized comparative study was conducted on elderly patients aged ≥ 60 years undergoing elective laparoscopic cholecystectomy under general anesthesia. Patients were randomized into three groups: Group P (propofol-based total intravenous anesthesia), Group S (sevoflurane-based inhalational anesthesia), and Group I (isoflurane-based inhalational anesthesia). Cognitive function was assessed preoperatively and postoperatively using the Mini-Mental State Examination (MMSE). Assessments were done at baseline, 6 hours, 24 hours, and 72 hours postoperatively. **Results:** A total of 90 patients were included (30 per group). Postoperative decline in MMSE scores was observed in all groups at 6 and 24 hours. However, the decline was significantly greater in the isoflurane group compared to propofol and sevoflurane groups ($p < 0.05$). Recovery of cognitive function at 72 hours was fastest in the propofol group, followed by sevoflurane, while persistent impairment was noted in the isoflurane group. **Conclusion:** Propofol is associated with better preservation and faster recovery of postoperative cognitive function compared to sevoflurane and isoflurane in elderly patients. Isoflurane shows the highest association with POCD. Anesthetic choice plays a crucial role in minimizing postoperative cognitive impairment in the elderly.

Keywords: Postoperative cognitive dysfunction, Propofol, Sevoflurane, Isoflurane, Elderly, Laparoscopic cholecystectomy

INTRODUCTION

Postoperative cognitive dysfunction (POCD) is characterized by impairment of memory, attention, and executive functions following surgery and anesthesia, particularly in elderly patients. With increasing life expectancy and a growing elderly population undergoing surgery, POCD has emerged as an important perioperative concern.

Elderly patients are more vulnerable to cognitive decline due to reduced neuronal reserve, age-related cerebral changes, and altered pharmacodynamics of anesthetic agents. Laparoscopic cholecystectomy, though minimally invasive, still involves general anesthesia and pneumoperitoneum, which can affect

cerebral perfusion and cognitive outcomes.

Among commonly used anesthetic agents, propofol, sevoflurane, and isoflurane differ in their mechanisms of action, cerebral metabolic effects, and neuroinflammatory responses. This study was undertaken to compare their impact on postoperative cognitive function in elderly patients undergoing laparoscopic cholecystectomy.

MATERIALS AND METHODS

Study Design and Setting

A prospective, randomized, comparative study conducted at a tertiary care teaching hospital after approval from the Institutional Ethics Committee.

Study Population

Elderly patients aged ≥ 60 years scheduled for elective laparoscopic cholecystectomy.

Inclusion Criteria

Age ≥ 60 years
ASA physical status I–III
MMSE score ≥ 24 preoperatively
Written informed consent

Exclusion Criteria

Pre-existing cognitive impairment or psychiatric illness
History of stroke or neurodegenerative disease
Alcohol or drug abuse
Conversion to open surgery
Intraoperative complications or prolonged surgery (>2 hours)
Randomization and Group Allocation

Patients were randomized into three equal groups:
Group P: Propofol-based total intravenous anesthesia
Group S: Sevoflurane-based inhalational anesthesia
Group I: Isoflurane-based inhalational anesthesia
Anesthetic Technique
Standard monitoring (ECG, NIBP, SpO₂, EtCO₂)
Induction with fentanyl and muscle relaxant
Maintenance with assigned anesthetic agent
BIS monitoring maintained between 40–60
Standard postoperative analgesia
Cognitive Assessment
Cognitive function was assessed using the Mini-Mental State Examination (MMSE) at:
Preoperative baseline
6 hours postoperative
24 hours postoperative
72 hours postoperative

Statistical Analysis

Data were analyzed using SPSS software. Continuous variables were expressed as mean $\pm$ SD. Intergroup comparison was done using ANOVA, and $p < 0.05$ was considered statistically significant.

RESULTS

Demographic Profile

There were no statistically significant differences among the three groups in terms of age, gender distribution, ASA status, duration of surgery, or anesthesia.

Table 1. Demographic Characteristics

Parameter	Group P	Group S	Group I
Mean Age (years)	66.4 $\pm$ 4.2	67.1 $\pm$ 4.6	66.8 $\pm$ 4.1
Male/Female	14 / 16	15 / 15	13 / 17
ASA I / II / III	Comparable across groups	Comparable across groups	Comparable across groups

Values are expressed as mean $\pm$ standard deviation or number of patients. ASA = American Society of Anesthesiologists.

MMSE Scores

Table 2. Mean MMSE Scores at Different Time Intervals

Time Interval	Group P	Group S	Group I
Preoperative	28.1 $\pm$ 1.2	27.9 $\pm$ 1.1	28.0 $\pm$ 1.0
6 hours	26.9 $\pm$ 1.3	26.2 $\pm$ 1.4	24.8 $\pm$ 1.6
24 hours	27.6 $\pm$ 1.1	26.9 $\pm$ 1.2	25.6 $\pm$ 1.5
72 hours	28.0 $\pm$ 1.0	27.7 $\pm$ 1.1	26.4 $\pm$ 1.4

Values are expressed as mean $\pm$ standard deviation. MMSE = Mini-Mental State Examination.

The decline was maximum in the isoflurane group ($p < 0.05$).

Recovery at 72 hours was complete in the propofol group, partial in sevoflurane, and incomplete in isoflurane group.

DISCUSSION

POCD is a multifactorial phenomenon influenced by patient age, surgical stress, inflammatory mediators, and anesthetic agents. This study demonstrates that the type of anesthetic agent significantly affects

postoperative cognitive outcomes in elderly patients. Propofol showed the least cognitive impairment and fastest recovery. Its neuroprotective effects may be attributed to reduced cerebral metabolic rate, antioxidant properties, and attenuation of neuroinflammatory responses. Propofol has also been shown to suppress cytokine release and maintain

cerebral autoregulation.

Sevoflurane demonstrated intermediate effects. Although it provides rapid induction and emergence, studies suggest that volatile agents may increase amyloid beta aggregation and neuroinflammation, contributing to transient cognitive impairment.

Isoflurane showed the highest incidence and persistence of POCD. Isoflurane has been associated with increased neuronal apoptosis, calcium dysregulation, and enhanced inflammatory pathways, especially in aged brains.

Our findings are consistent with previous studies that report lower POCD incidence with propofol compared to volatile anesthetics. The results highlight the importance of anesthetic selection in elderly patients to minimize postoperative neurocognitive complications.

Limitations

Single-center study

Small sample size

Short follow-up duration

Use of MMSE alone may not detect subtle cognitive changes

Further multicentric studies with larger samples and long-term follow-up are recommended.

CONCLUSION

Propofol-based anesthesia provides superior cognitive outcomes compared to sevoflurane

and isoflurane in elderly patients undergoing laparoscopic cholecystectomy. Isoflurane is associated with greater and prolonged postoperative cognitive dysfunction. Careful selection of anesthetic agents can significantly reduce POCD and improve postoperative recovery in elderly patients.

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