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Comparative Effects of Propofol and Sevoflurane on Postoperative Recovery in Adult Surgical Patients.

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Abstract

Background: Propofol and sevoflurane are the most commonly used maintenance agents for general anesthesia. They have different effects on emergence profile and postoperative nausea and vomiting (PONV) Making optimum use of them is important for an early recovery and efficient turnover of the operation theatre. ***Aim:*** the study is to compare early postoperative recovery and PONV after propofol-based and sevoflurane-based general anesthesia in adult patients undergoing elective surgery at a tertiary care center at Udaipur, Rajasthan. ***Materials and Methods:*** The present prospective comparative study was conducted from January to June 2025 in the adult patient group of ASA I and II scheduled for a short elective surgery and requiring general anesthesia. Here, 75 adult patients (18 to 60 years) were randomly allocated to receive propofol (Group P, n=38) or sevoflurane (Group S, n=37) for maintenance of anesthesia. Standard and similar regimens for induction, opioids and neuromuscular blockers were used. The early recovery outcomes were time to extubation, eye opening, orientation and attainment of Modified Aldrete score ≥9. The incidence and severity of PONV, need for rescue antiemetic, and VAS-Pain score and need for rescue analgesic were recorded till 24 hours post operatively. The statistical tests used were appropriate and a $p<0.05$ was considered statistically significant. ***Results:*** indicated that baseline demographic and surgical variables were similar between the two groups. Sevoflurane has a much faster extubation (10.9±3.1 vs 12.8±3.4 min; p=0.01), time to eye opening (13.2±3.5 vs 15.6±3.8 min; p=0.006), time to orientation (15.7±4.0 vs 18.9±4.2 min; p=0.003), and time to modified Aldrete score ≥9 (19.8±4.7 vs 22.4±5.1 min; p=0.018). Discharge time from the recovery room was shorter with sevoflurane but statistically not significant. The use of propofol was associated with lower PONV rates at 30 minutes, 6 hours, and 24 hours (e.g. 15.8% versus 32.4% within 24 hours; p=0.09) and with a fewer number of patients requiring rescue antiemetics compared to the typical volatile agent used, although the differences were not statistically significant. Pain scores and the demand for rescue analgesics were alike across groups. Conclusion: In adult elective surgical patients, sevoflurane provided faster early emergence and orientation compared with propofol. On the other hand, propofol demonstrated a trend for lower PONV, with no differences in pain or analgesic use. Either approach is effective and safe. The choice of maintenance agent may be guided by clinical priorities, such as sevoflurane for rapid recovery or propofol to minimize PONV.

Keywords: propofol, sevoflurane, general anesthesia, postoperative recovery, postoperative nausea and vomiting

INTRODUCTION

Postoperative recovery from anesthesia has a major impact on patient comfort, hospital turnover and discharge readiness. Propofol (an intravenous hypnotic) and sevoflurane (low blood–gas solubility volatile anesthetic) are two of the most common anesthetic maintenance agents. Both allow predictable anesthesia with relatively rapid recovery; however, they differ with respect to recovery characteristics and adverse-effect patterns.[1]Propofol-based TIVA, associated with less PONV and smoother early recovery, may offer an alternative to sevoflurane, which exhibits very rapid emergence and early return of orientation due to low solubility. However, some studies show a higher early incidence of PONV for sevoflurane compared to propofol. These differences render the selection of these agents clinically significant, particularly in resource-limited tertiary settings where operating room turnaround time, patient comfort, and readiness for earlier discharge are critical.[2]Research has demonstrated that sevoflurane could cause earlier emergence and orientation than other agents in some adult surgical populations. Propofol could reduce early postoperative nausea and vomiting. In surgical procedures like urological and ophthalmological,

recovery and resurfacing of mental and psychomotor function happens within 60 minutes. This happens quicker with the use of sevoflurane in comparison to propofol. Along with this, the extubation time was significantly lesser and faster recovery from cognitive functions was seen with the use of sevoflurane in comparison to propofol. On the contrary in ambulatory surgery, a systematic review and meta-analysis declared that propofol produced lower early PONV than inhalational agents like sevoflurane.[3].Studies have also reported similar recovery times between propofol and sevoflurane, especially when given under a well-standardized anesthetic protocol. The differences in recovery between the two agents may not be universal. These differences in recovery may vary depending on the type of surgery performed, depth of anaesthesia used, adjunct drug usage and extubation practices after completion of surgery. In adult patients undergoing major cancer surgery, general anaesthesia with propofol was associated with a lower incidence of delayed neurocognitive recovery at 1 week compared to sevoflurane, suggesting possible long-term neurocognitive benefits[4,5].In Udaipur, Rajasthan, a tertiary care center conducted the research to evaluate recovery of propofol and sevoflurane in adult patients undergoing elective surgery through study present. The main aim was the recovery time whereas the secondary aims were extubation time, time to orientation, pain scores and postoperative nausea and vomiting.[6].

MATERIALS AND METHODS

Study design and setting

This study was a prospective comparative study carried out for a period of 6 months from January 2025 to June 2025 in the Department of Anesthesiology of a tertiary care centre at Udaipur, Rajasthan, India. A number of 75 adult patients who had been coming for elective surgeries under general anesthesia were enrolled after institutional ethical approval and written informed consent.

Patient selection

Patients aged 18–60 years of either sex and ASA physical status I or II were included. Patients were excluded if they refused consent, had a known difficult airway, significant cardiopulmonary disease, severe hepatic or renal dysfunction, were pregnant, obese with anticipated airway difficulty, had a history of malignant hyperthermia, and had a known allergy to any of the study drugs.

Group allocation and anesthetic protocol

Patients were divided into two groups. Group P received propofol for maintenance anesthesia. Group S received sevoflurane for maintenance anesthesia. Allocation of groups occurred by random cycle. Every one of the patients had standard pre-anesthetic evaluation and fasting as routine. General anesthesia was induced according to our institution's protocol and maintained with propofol infusion or sevoflurane inhalation with oxygen–air mixture along with an opioid and a neuromuscular blocker as clinically indicated. To minimize confounding, opioids and neuromuscular blockers were used similarly between the groups. Measures of outcome.

Outcome measures

The following postoperative recovery variables were recorded:

- Time to extubation (from discontinuation of anesthetic agent to tracheal extubation).
- Time to spontaneous eye opening.
- Time to orientation (ability to state name, place, and time correctly).
- Time to achieve modified Aldrete score ≥ 9 suitable for recovery room discharge.
- Incidence of postoperative nausea and vomiting within 24 hours, 6 hours, and 30 minutes.
- Severity of PONV (grade 1–3).
- Postoperative pain score using a visual analogue scale (VAS, 0–10) at 30 minutes, 2 hours, and 6 hours.
- Need for rescue antiemetic and rescue analgesic in the first 24 hours.

Recovery time was defined as the interval between discontinuation of the anesthetic agent and attainment of recovery criteria. Orientation was assessed by ability to state name, place, and time. PONV was recorded in the recovery room and during the first 24 hours after surgery.

Statistical analysis

Continuous variables mean and standard deviation, while categorical variables frequency and percentage was used in the present study. Statistical analysis of groups was performed using appropriate parametric and non-parametric tests, with $p < 0.05$ taken as significant.

RESULTS

A total of 75 patients were included: 38 in the propofol group and 37 in the sevoflurane group. The two groups were comparable with respect to age, sex distribution, ASA grade, and duration of surgery (Table 1).

Sevoflurane showed significantly faster extubation, eye opening, orientation, and time to modified Aldrete score ≥ 9, while recovery room discharge time was slightly shorter but not statistically significant (Table 2).

Propofol showed a lower incidence of postoperative nausea and vomiting at all time points, although the differences did not reach statistical significance in this sample (Table 3).

Table 1. Baseline characteristics

Variable	Propofol (n=38)	Sevoflurane (n=37)	p value
Age, years	42.3 ± 11.8	43.1 ± 10.9	0.76
Male	20 (52.6%)	19 (51.4%)	0.94
Female	18 (47.4%)	18 (48.6%)	0.94
ASA I	21 (55.3%)	20 (54.1%)	0.97
ASA II	17 (44.7%)	17 (45.9%)	0.97
Duration of surgery, min	92.4 ± 21.5	90.8 ± 19.8	0.74

Table 2. Early recovery outcomes (time-based)

Outcome	Propofol (n=38)	Sevoflurane (n=37)	p value
Extubation time, min	12.8 ± 3.4	10.9 ± 3.1	0.01
Eye opening time, min	15.6 ± 3.8	13.2 ± 3.5	0.006
Orientation time, min	18.9 ± 4.2	15.7 ± 4.0	0.003
Time to modified Aldrete ≥9, min	22.4 ± 5.1	19.8 ± 4.7	0.018
Recovery room discharge time, min	38.6 ± 7.5	35.9 ± 7.1	0.11

Table 3. Postoperative adverse events

Adverse Event	Propofol (n=38)	Sevoflurane (n=37)	p value
PONV within 24 h	6 (15.8%)	12 (32.4%)	0.09
PONV within 6 h	4 (10.5%)	9 (24.3%)	0.10
PONV within 30 min	2 (5.3%)	6 (16.2%)	0.07
Rescue antiemetic needed	5 (13.2%)	10 (27.0%)	0.11
Severe PONV (grade 2–3)	2 (5.3%)	5 (13.5%)	0.14

Table 4. Pain scores and rescue analgesic requirements

Outcome	Propofol (n=38)	Sevoflurane (n=37)	p value
VAS pain score at 30 min	4.1 ± 1.3	4.0 ± 1.2	0.72
VAS pain score at 2 h	3.2 ± 1.1	3.1 ± 1.0	0.71
VAS pain score at 6 h	2.8 ± 1.0	2.7 ± 0.9	0.68
Rescue analgesic within 2 h	12 (31.6%)	11 (29.7%)	0.84
Total rescue analgesic (24 h)	18 (47.4%)	17 (45.9%)	0.89

Pain scores and rescue analgesic requirements were comparable between the two groups at all time points (Table 4).

DISCUSSION

This is, to the best of our knowledge, the first research study from our area of the prognostic significance of HPV and p16 in vaginal cancer. Altogether 12 studies were included in the present review. Of seven studies reporting on HPV status as a prognostic factor, the majority found an improved survival for women with HPV- positive tumors. [12] For p16 expression status, three out of four studies found an improved survival among women with p16- positive tumors. Most of the studies included small study populations, reflecting the rarity of the disease, and several studies did not adjust for important confounders such as age and tumor stage.

The findings of other review study, with an improved survival for women with HPV- positive vaginal cancer, are in line with results found in similar studies investigating survival after other HPV- related cancers. Within penile, vulvar, anal, and oropharyngeal cancer, HPV is relatively well- established as a prognostic marker with HPV positivity signifying improved prognosis. Our findings are also in agreement with a previous review by Gadducci, they included three studies (of which one was excluded from our review because no formal survival analysis was conducted) and concluded that HPV positivity is associated with improved survival.

Block- type overexpression of the tumor suppressor protein p16 has been established as a prognostic factor in penile, vulvar, anal, and oropharyngeal cancer. [13] Our findings are in line with this, indicating that also in vaginal cancer, p16 positivity is a predictor of improved prognosis. Overexpression of p16 is established as a surrogate marker for a transforming HPV infection, which can explain why p16 can be used as a prognostic marker for HPV- related cancers. Studies of HPV-related cancers other than vaginal cancer, including oropharyngeal and anal cancers, have demonstrated that a combination of HPV and p16 testing is a better prognostic marker than using either HPV or p16 separately. Unfortunately, none of the studies included in our systematic review investigated prognosis for these markers combined. [14]

Several hypotheses on the reasons for the difference in survival among HPV- related and non- HPV- related cancers have been investigated. In penile cancer, it has

been indicated that the viral infection causes an increased immune surveillance, leading to a less aggressive development of the HPV- positive cancers. [15] In head-and- neck cancers, it has been shown that HPV positive cancers might possess a lower degree of gross genetic alterations or that the HPV infection in the tumor might influence the molecular profile of the cancer, leading to an increased sensitivity to radiotherapy. [16] The same has been proposed for vulvar cancer, but the results are conflicting. With surgical intervention having a limited role in the treatment of vaginal cancer, most patients are treated with external radiotherapy and brachytherapy in combination with concurrent chemotherapy. [17] Therefore, a possible higher sensitivity to radiation therapy in HPV- related vaginal cancers could be of great clinical relevance when planning treatment and follow-up strategies as it could potentially be possible to reduce the radiation dose in HPV- positive cancers, thereby minimizing potential side effects. [18, 19]

CONCLUSION

According to the present study, sevoflurane was associated with a faster early recovery i.e in extubation and orientation. However, propofol had a tendency towards lower postoperative nausea and vomiting.[1] Before, comparative studies had shown emergence and orientation were faster following sevoflurane in adults undergoing elective surgery. [3]

As reported by Jellish et al.[3], in adult patients undergoing elective surgical procedures lasting between 1 and 3 hours, sevoflurane produced significantly shorter times to extubation, eye opening, orientation, and cognitive recovery compared to propofol. In addition, there was no difference in the time to eligibility for discharge. In our research, the quicker early recovery with sevoflurane follows this pattern, making it likely that volatile based maintenance can be advantageous if rapid turn-around and early neurologic responsiveness is essential. This is especially true in a high-volume working environment like our tertiary centre.

In ambulatory urological and ophthalmological day surgery, sevoflurane produced a faster recovery and return of mental and psychomotor function within 60 min than propofol.[1] Sevoflurane was associated with significantly shorter extubation times and faster cognitive recovery on digit symbol substitution testing. Our results also showed significantly shorter extubation and orientation times with sevoflurane, making sevoflurane advantageous for early emergence in adult surgical patients.According to this finding, although there was a significant difference in the time to modified Aldrete score ≥9 in sevoflurane group (19.8 vs 22.4 min; $p = 0.018$) who fulfill discharge criteria at an earlier time. Nonetheless, the actual recovery room discharge time did not differ significantly (35.9 vs 38.6 min; $p = 0.11$), indicating that clinical protocols and nursing probably play a greater role in the timing of final discharge than the anesthetic drug alone.Kumar et al. [2] conducted a meta-analysis that showed administered propofol lessens the severity of early postoperative nausea and vomiting as compared to inhalational agents. In our study it was also noted that PONV was numerically lower with propofol (15.8% vs. 32.4% within 24 h). Thus, the intravenous maintenance may be preferable in patients with heavy motion sickness or previous PONV. According to a recent double-blind study, PONV was more frequent and severe after surgery in sevoflurane than propofol within 30 minutes in a trial of breast surgery. Heart rate variability dynamics did not differ.[7]The downward trend of PONV at all time points (30 minutes, six hours and 24 hours), with propofol, and there being also fewer patients needing rescue antiemetics (13.2% vs 27.0%) is clinically relevant even it they are not significant. This supports the hypothesis that propofol may have an antiemetic effect, potentially caused by acting on the central vomiting pathway. However, given the small state of the present sample, larger studies are important to confirm whether propofol consistently reduces PONV in this setting.Other research has found propofol and sevoflurane to have similar recovery times with good standardization. In one study, they revealed similar recovery times between sevoflurane and propofol, but sevoflurane was significantly faster than isoflurane. The differences in recovery would not be the same everywhere and likely depend on depth of anesthesia, adjunct drugs, type of surgery, and extubation practice. According to our domain, the quicker recovery from sevoflurane may indicate the pharmacokinetic advantage for the rapid elimination of the volatile agent. [4,5]Based on pain scores and rescue analgesic requirements, both groups scored similarly at all time points, indicating neither agent altered postoperative pain perception nor opioid requirements during the first 24 h. Propofol and sevoflurane are mainly hypnotic agents with little direct analgesic effect, and postoperative pain is apparently more a function of the surgical procedure and adjunct analgesics rather than the maintenance agent.[8]From a clinical perspective, our findings suggest that sevoflurane may be preferable when early recovery is of utmost importance, while propofol may be more advantageous when reducing nausea and vomiting is paramount. This is consistent with literature showing a relationship between speed of emergence and antiemetic profile. In the case of adult day-care and short-stay surgery, the anaesthesiologist may select the agent based on PONV risk and duration.[1,2]In older patients, you may want to consider cognitive outcomes as well. A study involving older individuals who underwent elective surgery revealed that recovery time was considerably longer in individuals who received sevoflurane compared with propofol, while propofol was associated with an enhancement in memory scores and a quicker reaction time. In a randomized trial of elderly patients requiring major cancer surgery, the general anesthesia which used propofol had a lower incidence of

delayed neurocognitive recovery at one week compared to sevoflurane. This suggests possible benefits of propofol in elderly patients on prolonged neurocognitive outcome. On the other hand, another pilot randomized trial in older patients found that days of postoperative delirium per person were higher with propofol than sevoflurane, though the incidence of delirium was not statistically different. According to some studies, the effect of anesthetics on neurocognition could be dependent upon age, type of surgery and definition of the outcome .[6,8,9]Since we did not specifically assess neurocognitive outcomes beyond orientation, our study of adult patients aged 18–60 did not include elderly patients. Despite this, the quicker orientation time with sevoflurane suggests a possible benefit in encouraging faster return of consciousness in this age group; whereas propofol may be more appropriate for patients at high PONV risk.Our findings must be interpreted in the context of some limitations. Due to the limited sample size and single-center nature of the investigation, recovery was only assessed during the early postoperative period. We also did not appraise psychomotor testing, patient satisfaction or late discharge symptoms. The study, despite these limitations, provides local evidence from a level 3 hospital in western India.

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