RECOVERY PROFILE AND COGNITIVE FUNCTION AFTER GENERAL ANAESTHESIA: A STUDY COMPARING DESFLURANE AND SEVOFLURANE IN A TERTIARY CARE HOSPITAL SOUTHERN INDIA

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Abstract:

Background:
Rapid emergence from general anaesthesia with early recovery of cognitive function is crucial for improved postoperative outcomes, patient satisfaction, and operating room efficiency. Volatile anaesthetic agents such as desflurane and sevoflurane differ in their pharmacokinetic properties, which may influence emergence characteristics and early cognitive recovery. Understanding these differences is particularly important in the context of enhanced recovery protocols and ambulatory surgeries.

Aim:
To compare emergence characteristics and early postoperative cognitive recovery in adult patients undergoing general anaesthesia with desflurane versus sevoflurane.

Methods:
This prospective randomized comparative study was conducted in the Department of

Anaesthesiology at Sree Mookambika Institute of Medical Sciences. Ninety-two patients aged 18–50 years, classified as ASA physical status I and II, undergoing elective surgeries of 2–3 hours duration were included. Patients were randomly allocated into two groups: Group A received sevoflurane and Group B received desflurane for maintenance of anaesthesia at 1 MAC. Standardized anaesthetic techniques were followed in both groups. Emergence parameters including time to spontaneous breathing, response to pain, extubation, and cognitive recovery were recorded. Early cognitive function was assessed using the Digit Symbol Substitution Test (DSST), and recovery was evaluated using the Modified Aldrete Score (MAS).

Results:
Demographic variables and duration of surgery were comparable between the two groups ($p > 0.05$). Hemodynamic parameters remained stable with no significant differences. The requirement for additional fentanyl was significantly higher in the desflurane group ($p < 0.001$). Emergence and recovery times were significantly shorter in the desflurane group, including time to spontaneous breathing, response to pain, extubation, and recall of personal information ($p < 0.001$). Neuromuscular recovery and achievement of adequate recovery scores (MAS > 9) were also faster with desflurane. Cognitive recovery, assessed by DSST, occurred earlier in the desflurane group compared to sevoflurane ($p < 0.001$).

Conclusion:
Both desflurane and sevoflurane provide stable intraoperative hemodynamics; however, desflurane offers significantly faster emergence, early recovery, and cognitive function. Despite a higher requirement for supplemental opioids, desflurane may be preferred in clinical scenarios where rapid recovery is desired.

Keywords:
Desflurane, Sevoflurane, Emergence, Cognitive recovery, DSST, General anaesthesia

Introduction

Rapid emergence from general anaesthesia with early restoration of cognitive function is a key determinant of postoperative recovery, patient satisfaction, and operating room efficiency. Volatile anaesthetic agents differ in their pharmacokinetic properties, which can significantly influence emergence characteristics and early postoperative cognitive performance. Postoperative cognitive dysfunction (POCD), though often transient in adults, may delay recovery, prolong hospital stay, and impair early postoperative functioning.[1]

Desflurane and sevoflurane are commonly used modern inhalational anaesthetic agents because of their favorable safety profiles and rapid onset of action. Desflurane has a lower blood–gas partition coefficient compared to sevoflurane, resulting in faster elimination and potentially quicker emergence from anaesthesia.[2] Sevoflurane, while slightly more soluble, is well tolerated and widely preferred due to its smooth induction and minimal airway irritation.[3]

Several studies have evaluated emergence times and early recovery profiles of these agents; however, results regarding their effects on early postoperative cognitive recovery remain variable.[4–6] Given the increasing emphasis on enhanced recovery protocols and day-care surgeries, understanding differences in cognitive recovery between desflurane and sevoflurane is clinically relevant. This study aims to compare emergence characteristics and early cognitive recovery in adult patients undergoing general anaesthesia with desflurane or sevoflurane.

Aim

To compare the emergence characteristics and early postoperative cognitive recovery in adult patients undergoing general anaesthesia with desflurane versus sevoflurane.

Objectives

To compare the time to emergence following general anaesthesia using desflurane and sevoflurane.

To assess and compare early postoperative cognitive function between the two anaesthetic agents using standardized cognitive assessment tools.

Methodology

Study Design and Setting

This was a prospective, randomized, comparative study carried out in the Department of Anaesthesiology at Sree Mookambika Institute of Medical Sciences. Approval was obtained from the Institutional Ethics Committee prior to commencement of the study. Written informed consent was obtained from all participants. Ninety-two patients aged between 18 and 50 years were enrolled.

Study Population

Patients classified as American Society of Anesthesiologists (ASA) physical status I and II, scheduled for elective surgical procedures under general anaesthesia with an anticipated duration of 2 to 3 hours, were included in the study.

Exclusion Criteria

Patients with clinically significant cardiovascular, respiratory, hepatic, renal, neurological, psychiatric, or metabolic illnesses were excluded. Additional exclusion criteria included a history of malignant hyperthermia, anticipated difficult airway, exposure to anaesthesia within the preceding seven days, and long-term use of opioid analgesics or sedative medications.

Preoperative Evaluation

A comprehensive preoperative assessment was conducted for all patients, including detailed airway evaluation and assessment of neck mobility to exclude difficult intubation. Routine investigations included complete blood count, liver and renal function tests, blood glucose levels, serum electrolytes, coagulation profile, urine analysis, electrocardiography, and echocardiography and chest radiography when clinically indicated.

Patients with hypertension were advised to continue their antihypertensive medications on the day of surgery. Diabetic patients were instructed to withhold the morning dose of insulin. These patients were scheduled as the first case of the day, and fasting blood glucose and urine acetone levels were documented on the day of surgery.

All patients were kept nil per oral for a minimum of six hours prior to surgery. Premedication consisted of oral pantoprazole 40 mg and alprazolam 0.25 mg administered on the night before surgery.

Anaesthetic Management

Standard monitoring prior to induction included electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry (SpO_2). Intravenous midazolam 0.03 mg/kg and fentanyl 2 µg/kg were administered as premedication. Pre-oxygenation was performed using 100% oxygen for three minutes.

Anaesthesia was induced with intravenous propofol 2 mg/kg, and endotracheal intubation was facilitated using atracurium 0.5 mg/kg. Patients were randomly assigned into two groups:

Group A: Maintenance of anaesthesia with 1 MAC sevoflurane

Group B: Maintenance of anaesthesia with 1 MAC desflurane

Both volatile agents were delivered in a mixture of 50% oxygen and 50% nitrous oxide at a total fresh gas flow of 1 L/min using a closed-circuit system.

Intraoperative analgesia was provided with intravenous morphine 0.1 mg/kg administered five minutes after induction. If there was a rise in heart rate or mean arterial pressure exceeding 20% of baseline values, a rescue dose of fentanyl 1 µg/kg was administered.

Mechanical ventilation was adjusted to maintain end-tidal carbon dioxide levels between 30 and 35 mmHg. Neuromuscular blockade was maintained with intermittent doses of atracurium 0.1 mg/kg administered every 30 minutes.

Emergence and Recovery

At the completion of surgery, sevoflurane, desflurane, and nitrous oxide were discontinued following the final skin suture. Controlled ventilation was continued with 100% oxygen at a flow rate of 10 L/min, tidal volume of 5–7 mL/kg, and respiratory rate of 10 breaths per minute until spontaneous respiration was restored. Neuromuscular blockade was reversed using neostigmine

0.05 mg/kg and glycopyrrolate 0.01 mg/kg. Extubation was performed once patients were fully awake and responsive.

Outcome Assessment

The time to return of spontaneous respiration, eye opening, and extubation following discontinuation of anaesthetic agents was recorded. Hemodynamic parameters including ECG, pulse rate, systolic, diastolic and mean arterial pressures, and oxygen saturation were continuously monitored. Expired concentrations of volatile anaesthetic agents were documented at five-minute intervals during the first 60 minutes and subsequently at 30-minute intervals until the end of the procedure.

Early recovery was evaluated by assessing the time to spontaneous breathing, response to painful stimuli, response to verbal commands, and the ability to correctly state name and date of birth. Intermediate recovery was assessed using the modified Aldrete's score recorded upon arrival in the post-anaesthesia care unit (PACU) and at 5 and 10 minutes thereafter. Cognitive recovery was evaluated using the Digit Symbol Substitution Test (DSST) in the PACU.

Statistical Analysis

Data were analysed after testing for normality. Continuous variables with normal distribution were expressed as mean ± standard deviation, while non-normally distributed data were expressed as median with interquartile range. Categorical variables were presented as frequencies .Categorical variables were analysed using the chi-square test. A p-value of less than 0.05 was considered statistically significant. Statistical analysis was performed using SPSS software and Microsoft Excel.

Results

Table 1. Demographics and duration of surgery

Demographic and Other Data			
Parameters	**Desflurane Group(mean)**	**Sevoflurane Group (mean)**	**P value**
Age	37.67	40.07	0.321948
Sex (Male: Female)	23:23	23:23	1.0
Weight (kg)	69.28	65.13	0.07714
Duration of Surgery	156.87	153.39	0.340491

Table 2. Haemodynamic parameters and additional dose of fentanyl used

Hemodynamic Parameters			
Parameters	**Desflurane Group (mean)**	**Sevoflurane Group (mean)**	**P value**
Changes in MAP	84.07+/-9.37	82.82+/-7.81	0.6172
Changes in pulse rate	76.51+/-10.68	76.38+/-10.64	0.953
Additional fentanyl dose required	2 doses – 3 1 dose - 25	2 doses – 1 1 dose - 9	0.000393

Table 3. Emergency and recovery times after discontinuation of anaesthesia

Emergency and Recovery Times after Discontinuation of Anaesthesia			
Parameters	**Desflurane Group**	**Sevoflurane Group**	**P value**
Time for spontaneous breathing (minutes)	3.87	6.26	0
Time to respond to pain (minutes)	5.96	8.83	0
Time to extubation (minutes)	6.96	11.28	0
Time to recall of name (minutes)	8.39	13.24	0
Time to recall date of birth (minutes)	8.39	13.35	0
Time to hand grip (minutes)	10.17	15.02	0
Time to limb lift (minutes)	10.17	15.11	0
Time to achieve MAS >12	14.09	18.52	0

Time to complete DSST (minutes)	55.83	61.24	0

MAS – Modified Aldrete Score

DSST – Digital Symbol Substitution Test

Discussion

The present prospective, randomized comparative study evaluated the effects of desflurane and sevoflurane on hemodynamic stability, emergence, and early postoperative recovery in patients undergoing elective surgeries under general anaesthesia. The principal findings of this study demonstrate that while both anaesthetic agents provided comparable intraoperative hemodynamic stability, desflurane was associated with significantly faster emergence and recovery profiles compared to sevoflurane.

In the current study, demographic variables such as age, sex distribution, body weight, and duration of surgery were comparable between the two groups, ensuring homogeneity and minimizing confounding factors. This comparability strengthens the validity of the observed differences in emergence and recovery characteristics, which can be attributed primarily to the pharmacokinetic properties of the inhalational agents used.

Hemodynamic parameters, including heart rate and mean arterial pressure, remained stable and did not differ significantly between the two groups throughout the intraoperative period. These findings are consistent with earlier studies that have demonstrated comparable cardiovascular stability with both desflurane and sevoflurane when administered at equivalent MAC levels in healthy patients (1,2). Although desflurane is known to cause sympathetic stimulation at higher concentrations, particularly during rapid increases in concentration, the use of 1 MAC with controlled administration likely mitigated these effects in the present study.

The requirement for additional intraoperative fentanyl was significantly higher in the desflurane group. This finding may be explained by the relatively lower intrinsic analgesic properties of desflurane and its tendency to cause airway irritation and sympathetic responses, which can manifest as increases in heart rate and blood pressure during surgical stimulation (3). Similar observations have been reported in previous studies, where desflurane-based anaesthesia required greater opioid supplementation compared to sevoflurane (4).

One of the most notable findings of this study was the significantly faster emergence from anaesthesia observed in the desflurane group. Time to spontaneous breathing, response to painful stimuli, verbal commands, and recall of personal information were all shorter in patients receiving desflurane. This can be attributed to the lower blood–gas partition coefficient of desflurane compared to sevoflurane, resulting in more rapid elimination from the body and quicker recovery of consciousness (5,6).

Neuromuscular recovery parameters, including time to hand grip and limb lift, were also achieved earlier in the desflurane group. Furthermore, patients anaesthetised with desflurane attained a Modified Aldrete Score greater than 9 in a significantly shorter duration, indicating faster achievement of criteria for discharge readiness from the post-anaesthesia care unit. These findings are in agreement with previous studies demonstrating quicker early and intermediate recovery with desflurane compared to sevoflurane (7,8).

Cognitive recovery, assessed using the Digit Symbol Substitution Test (DSST), occurred significantly earlier in the desflurane group. Early restoration of cognitive function is particularly advantageous in ambulatory and short-stay surgeries, as it facilitates early mobilization, patient cooperation, and faster discharge. The rapid washout characteristics of desflurane likely contribute to this improved cognitive recovery profile (9).

Despite its advantages in terms of faster recovery, the increased opioid requirement associated with desflurane should be considered, especially in patients where opioid-related adverse effects are a concern. Sevoflurane, while associated with slightly slower emergence, offers smoother induction and lower airway irritation, making it a suitable alternative in certain patient populations.

Limitations

The study was limited to ASA I and II patients and surgeries of moderate duration; therefore, the findings may not be generalizable to high-risk patients or prolonged surgeries. Additionally, long-term postoperative outcomes and patient satisfaction were not evaluated.

Conclusion

Both desflurane and sevoflurane provide stable intraoperative hemodynamics when used at equipotent concentrations. However, desflurane offers the advantage of significantly faster emergence, early recovery, and cognitive function compared to sevoflurane, albeit with a higher requirement for supplemental opioids. These findings support the use of desflurane in situations where rapid recovery is desirable.

References :

1. Newman MF, Stygall J, Hirani S, Shaefi S, Maze M. Postoperative cognitive dysfunction after noncardiac surgery: a systematic review. Anesthesiology. 2007;106(3):572–90.
2. Eger EI II. Characteristics of anesthetic agents used for induction and maintenance of general anesthesia. Am J Health Syst Pharm. 2004;61(Suppl 4):S3–10.
3. Miller RD, Cohen NH, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Young WL. Miller's Anesthesia. 9th ed. Philadelphia: Elsevier; 2020.
4. Song D, Joshi GP, White PF. Titration of volatile anesthetics using bispectral index facilitates recovery after ambulatory anesthesia. Anesthesiology. 1997;87(4):842–8.

5. Chen X, Zhao M, White PF, et al. The recovery of cognitive function after general anesthesia in elderly patients: a comparison of desflurane and sevoflurane. Anesth Analg. 2001;93(6):1489–94.
6. Mahmoud NA, Rose DJ. Desflurane versus sevoflurane for maintenance of anesthesia: a meta-analysis of emergence and recovery characteristics. Can J Anaesth. 2019;66(8):977–89.

7. Eger EI II. Characteristics of anesthetic agents used for induction and maintenance of general anesthesia. Am J Health Syst Pharm. 2004;61 Suppl 4:S3–10.
8. Nathanson MH, Fredman B, Smith I, White PF. Sevoflurane versus desflurane for outpatient anesthesia: a comparison of maintenance and recovery profiles. Anesth Analg. 1995;81:1186–1190.
9. Weiskopf RB, Moore MA, Eger EI II, et al. Rapid increases in desflurane concentration cause transient sympathetic stimulation. Anesthesiology. 1994;81:1035–1045.
10. Mahmoud NA, Rose DJ, Laurence AS. Desflurane or sevoflurane for ambulatory anaesthesia: a comparison of recovery characteristics. Br J Anaesth. 2001;87:823–826.
11. Eger EI II, Saidman LJ, Brandstater B. Minimum alveolar anesthetic concentration: a standard of anesthetic potency. Anesthesiology. 1965;26:756–763.
12. Heavner JE. Blood/gas solubility of inhaled anesthetics. Anesth Analg. 1998;86:976–980.
13. White PF, Song D. New criteria for fast-tracking after outpatient anesthesia: a comparison with the modified Aldrete scoring system. Anesth Analg. 1999;88:1069–1072.
14. Larsen B, Seitz A, Larsen R. Recovery of cognitive function after sevoflurane and desflurane anesthesia. Acta Anaesthesiol Scand. 2000;44:334–339.
15. Newman MF, Stygall J, Hirani S, Shaefi S, Maze M. Postoperative cognitive dysfunction after noncardiac surgery: a systematic review. Anesthesiology. 2007;106:572–590.