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Original Research Article

Desflurane versus Sevoflurane for Postoperative Cognitive Function in Patients Undergoing Major Cancer Surgery under General Anaesthesia: A Prospective, Randomised, Double-Blinded Hospital-Based Study

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Conflict of interest: Nil

Abstract

Background: Postoperative cognitive dysfunction (POCD) is an important concern after major surgery, particularly in cancer patients in whom prolonged procedures, inflammatory response, pain, psychological stress and perioperative physiological changes may affect recovery. Desflurane and sevoflurane are commonly used volatile anaesthetic agents. Desflurane has lower blood-gas solubility and may produce faster early recovery, but its advantage in postoperative cognitive outcomes remains uncertain.

Methods: This prospective, randomised, double-blinded, hospital-based study included 80 adult patients aged more than 20 years, of either sex, ASA physical status I-III, posted for elective major cancer surgeries under general anaesthesia. Patients were randomly allocated into Group D (desflurane for maintenance, n = 40) or Group S (sevoflurane for maintenance, n = 40). Anaesthesia was induced with midazolam, fentanyl and propofol, with neuromuscular blockade by succinylcholine to facilitate endotracheal intubation. Volatile agents were titrated to maintain approximately 1 MAC. Postoperative cognitive function was assessed using the Mini-Mental State Examination (MMSE) 12 hours before surgery and on postoperative days 1, 3 and 5 after extubation. Secondary outcomes included comparison of POCD, hemodynamic stability, time to eye opening, time to extubation, time to Modified Aldrete score >9, recovery profile and complications. Data were analysed using Welch independent t-test, chi-square test and Fisher exact test; $p < 0.05$ was considered statistically significant.

Results: Baseline demographic and clinical variables were comparable between the groups. Heart rate, mean arterial pressure and SpO2 remained statistically comparable at all recorded time intervals. Volatile agent consumption was significantly higher in Group D than Group S (156.85 ± 49.62 mL vs 84.99 ± 21.67 mL; $p < 0.0001$), despite the longer duration of surgery in Group S (191.25 ± 49.78 min vs 232.50 ± 57.55 min; $p = 0.0010$). Desflurane was associated with significantly earlier eye opening (9.61 ± 0.80 min vs 10.65 ± 1.03 min; $p < 0.0001$), earlier extubation (11.37 ± 0.89 min vs 12.39 ± 0.97 min; $p < 0.0001$) and earlier achievement of Modified Aldrete score >9 (13.01 ± 0.94 min vs 13.85 ± 0.95 min; $p = 0.0002$). MMSE scores were comparable preoperatively and on postoperative days 1, 3 and 5. POCD occurred in 1 patient (2.5%) in Group D and 2 patients (5.0%) in Group S ($p = 1.000$).

Conclusion: Desflurane provided faster and early recovery than sevoflurane and postoperative cognitive function and the incidence of POCD were statistically similar in both groups. Both agents appear comparable with respect to short-term postoperative cognitive outcomes in patients undergoing major cancer surgery under general anaesthesia.

Keywords: Desflurane; Sevoflurane; Postoperative Cognitive Dysfunction; Mini-Mental State Examination; Cancer Surgery; General Anaesthesia; Early Recovery.

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Introduction

Postoperative cognitive function is an important determinant of quality of recovery after general anaesthesia. It includes memory, attention, concentration, language, decision-making and visuospatial abilities. A measurable decline from the preoperative cognitive baseline after surgery is commonly described as postoperative cognitive dysfunction (POCD). The pathogenesis of POCD is multifactorial and may involve neuroinflammation, cerebral hypoperfusion, neurotransmitter imbalance, perioperative pain, sleep disturbance and the residual effects of anaesthetic and analgesic drugs [1,2,3].

POCD is particularly important in patients undergoing major cancer surgery as oncological procedures are often prolonged, involve extensive tissue manipulation and are associated with a significant inflammatory response. Cancer patients may also have additional risk factors such as nutritional impairment, psychological stress, previous chemotherapy or radiotherapy and variable physiological reserve. These factors may increase vulnerability to postoperative neurocognitive changes and delay return to baseline function.

Desflurane and sevoflurane are commonly used volatile anaesthetic agents for maintenance of general anaesthesia. Both agents permit rapid titration of anaesthetic depth and allow recovery after discontinuation. Desflurane has a lower blood-gas partition coefficient than sevoflurane, resulting in rapid wash-in and washout and earlier emergence from anaesthesia. Sevoflurane, on the other hand, is less airway-irritant and is widely used due to its stable clinical profile [4,5,6].

Previous studies and meta-analyses have shown that desflurane may reduce early recovery times such as response to commands, extubation, orientation and recovery room discharge. However, these faster early recovery endpoints do not consistently translate into a lower incidence of POCD or superior longer-term cognitive recovery [7,8,9]. Moreover, fewer studies have focused specifically on patients undergoing major cancer surgeries.

Therefore, this study was conducted to compare the effects of desflurane and sevoflurane on postoperative cognitive function in patients undergoing major cancer surgery under general anaesthesia.

Methods

Trial Registration and Ethics: The trial was registered prospectively with the clinical trial registry – India - CTRI/2026/04/108851 [Registered on: 21/04/2026]. Institutional Ethics Committee Approval and written informed patient consent were obtained prior to enrolment.

Study Design and Setting: This was a prospective, randomised, double-blinded, hospital-based study conducted under Department of Anaesthesia, over a period of three months, in Onco surgery operation theatre, Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, Rajasthan, India, after approval from the Institutional Ethics Committee and after obtaining written informed consent from all participants.

Study Population: Patients aged more than 20 years, of either sex, ASA physical status I, II or III, posted for elective major cancer surgery under general anaesthesia, were included. Patients with known allergy or sensitivity to volatile anaesthetic agents, history of malignant hyperthermia, significant hepatic, renal or cardiovascular disease, pre-existing lung disease or recent respiratory infection, pregnancy or lactation, use of sedative or psychiatric medication affecting cognition, and those undergoing emergency surgery were excluded.

Sample Size: Sample size was calculated using data from Dong et al. [15] for cognitive score differences between desflurane and sevoflurane groups. With a pooled SD of 1.57, minimum clinically important difference of 1.09, alpha error of 5%, power of 80% and 10% attrition allowance, 37 patients were required in each group. The final sample size was rounded to 40 patients per group, giving a total sample size of 80.

Randomization and Blinding: Patients were randomly allocated by simple randomisation using a computer-generated random table into two equal groups. Group D received desflurane and Group S received sevoflurane for maintenance of anaesthesia.

The patient and data collector were blinded to group allocation. The anaesthesiologist administering the volatile agent was different from the anaesthesiologist who performed MMSE assessment before and after surgery.

Anaesthesia Technique: A day before surgery, detailed history, general physical examination and systemic examination were performed. Patients were instructed about MMSE assessment. Routine investigations were noted, overnight fasting was advised and clear fluids were allowed up to 2 hours before surgery as per fasting guidelines. MMSE was recorded 12 hours before surgery. Premedication with oral ranitidine 150 mg and alprazolam 0.25-0.5 mg was given on the night before surgery, according to body weight.

In the operating theatre, after the conformation of case, and attaching the ASA standard monitors, baseline heart rate, mean arterial pressure and SpO2 were recorded. Intravenous access was secured with an 18G cannula. Premedication consisted of midazolam 0.03 mg/kg IV and fentanyl 2 mcg/kg IV. Anaesthesia was induced with propofol 2 mg/kg IV slowly until loss of verbal response. Neuromuscular blockade was achieved with vecuronium 0.1 mg/kg IV or succinylcholine 2 mg/kg IV to facilitate endotracheal intubation. Intubation was done, bilateral equal air entry was checked by auscultation and confirmed using capnography. In Group D, anaesthesia was maintained with desflurane along with oxygen, and in Group S, anaesthesia was maintained with sevoflurane along with oxygen, adjusted to maintain MAC value of approximately 1. Controlled ventilation was used to maintain EtCO2 between 35 and 45 mmHg. Additional fentanyl and vecuronium were given intraoperatively as per requirement.

Outcome Measures: The primary outcome was postoperative cognitive function assessed by MMSE at 12 hours preoperatively and on postoperative days 1, 3 and 5 after extubation. Secondary outcomes included incidence of POCD, heart rate, mean arterial pressure, SpO2, volatile anaesthetic consumption, duration of surgery/anaesthesia, time to eye opening, time to extubation, time to Modified Aldrete score >9, recovery profile and postoperative complications. Time points for intraoperative monitoring included preoperative value, T0, T1, T2, T15, T30, T45, T60, T90, T120, T150, T180, T210, T240, T270 and T300 minutes as applicable.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using SPSS version 23.0. Continuous variables were expressed as mean ± standard deviation and compared using Welch independent t-test. Categorical variables were expressed as frequency and percentage and compared using chi-square test or Fisher exact test, as appropriate. A p-value < 0.05 was considered statistically significant.

Results

A total of 80 patients were included, with (n = 40) patients in Group D and 40 patients in Group S. Baseline demographic data and clinical characteristics were comparable between the two groups. The groups were comparable with respect to sex distribution, educational status, addiction history, BMI, age and ASA grade (Table 1).

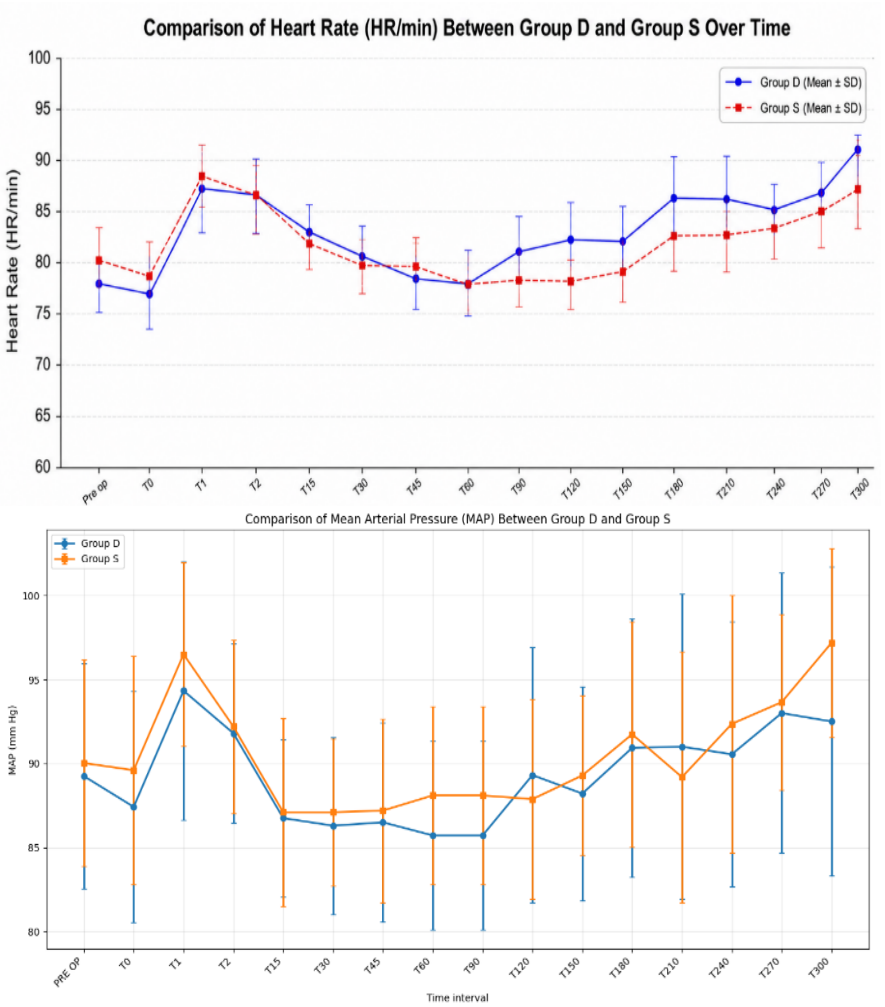
Table 1: Baseline characteristics of patients in Group D and Group S (N = 80)

Parameter	Group D - Desflurane (n = 40)	Group S - Sevoflurane (n = 40)	p-value	Significance
Sex: Female / Male	24 (60.0%) / 16 (40.0%)	18 (45.0%) / 22 (55.0%)	0.1792	NS
Education: Secondary / Primary / Uneducated	8 (20.0%) / 16 (40.0%) / 16 (40.0%)	8 (20.0%) / 17 (42.5%) / 15 (37.5%)	0.9692	NS
Addiction: No / Tobacco / Smoking / Drinking	30 (75.0%) / 6 (15.0%) / 4 (10.0%) / 0 (0.0%)	23 (57.5%) / 12 (30.0%) / 4 (10.0%) / 1 (2.5%)	0.2697	NS
BMI (kg/m2), mean ± SD	21.46 ± 1.10	21.91 ± 1.07	0.0646	NS
Age (years), mean ± SD	52.10 ± 14.26	49.90 ± 11.86	0.4556	NS
ASA grade, mean ± SD	2.48 ± 0.51	2.52 ± 0.51	0.6596	NS

Heart rate remained comparable between the two groups at all recorded time intervals.

The baseline preoperative heart rate was 78.10 ± 7.15 beats/min in Group D and 80.33 ± 6.63 beats/min in Group S. There was a transient rise around intubation in both groups, At T1 (at the time of intubation) and T2 (5 minutes after the intubation), however, the differences were statistically non-significant (p = 0.5859 and p = 0.9803 respectively).

MAP and SpO2 were also comparable throughout the intraoperative period (Table 2).



Graph 1: Key haemodynamic parameters between Group D and Group S

Anaesthetic agent consumption was significantly higher in Group D compared with Group S.

The mean volume consumed in Group D was 156.85 ± 49.62 ml, whereas in Group S it was 84.99 ± 21.67 ml. The recorded duration was significantly longer in Group S (232.50 ± 57.55 minutes) as compared to group D (191.25 ± 49.78 minutes). Desflurane was associated with significantly faster early recovery, with shorter time to eye opening 9.61 ± 0.80 minutes in Group D and 10.65 ± 1.03 minutes in Group S, with a highly significant p value of <0.0001, shorter time for extubation 11.37 ± 0.89 minutes in Group D and 12.39 ± 0.97 minutes in Group S, with p <0.0001 and shorter time taken to achieve Modified Aldrete score >9, (13.01 ± 0.94 minutes in Group D and 13.85 ± 0.95 minutes in Group S, with p = 0.0002). (Table 3).

Table 3: Anaesthetic consumption, duration and early recovery endpoints

Variable	Group D - Desflurane	Group S - Sevoflurane	Test value	p-value	Significance
Volatile agent consumption (mL)	156.85 ± 49.62	84.99 ± 21.67	t = 8.39	<0.0001	Significant
Duration (min)	191.25 ± 49.78	232.50 ± 57.55	t = -3.43	0.0010	Significant
Time to eye opening (min)	9.61 ± 0.80	10.65 ± 1.03	-	<0.0001	Significant
Time to extubation (min)	11.37 ± 0.89	12.39 ± 0.97	-	<0.0001	Significant
Time to Modified Aldrete score >9 (min)	13.01 ± 0.94	13.85 ± 0.95	-	0.0002	Significant

Recovery profile and postoperative complications were comparable between groups. Smooth recovery was observed in 82.5% of Group D and 90.0% of Group S patients. Most patients in both groups had no complications (Table 4).

Table 4: Recovery profile and postoperative complications

Variable	Category	Group D n (%)	Group S n (%)	Total n (%)	p-value
Recovery profile	Smooth	33 (82.50%)	36 (90.00%)	69 (86.25%)	0.3301
	Eventful	7 (17.50%)	4 (10.00%)	11 (13.75%)	
Complications	Nil	33 (82.50%)	36 (90.00%)	69 (86.25%)	0.3469
	Cough	3 (7.50%)	0 (0.00%)	3 (3.75%)	
	Confused	2 (5.00%)	2 (5.00%)	4 (5.00%)	
	Hoarseness	1 (2.50%)	0 (0.00%)	1 (1.25%)	
	Agitated	1 (2.50%)	2 (5.00%)	3 (3.75%)	

Preoperative MMSE scores were comparable between the groups. Both groups showed a mild reduction in MMSE on postoperative day 1, followed by gradual return toward baseline by postoperative day 5. Intergroup differences were statistically non-significant at all assessment times. POCD was observed in 1 patient in Group D and 2 patients in Group S, with no statistically significant difference (Table 5).

Table 5: MMSE scores and incidence of POCD

Outcome	Group D - Desflurane	Group S - Sevoflurane	p-value	Significance
MMSE preoperative	27.75 ± 0.71	27.80 ± 0.69	0.7492	NS
MMSE postoperative day 1	26.98 ± 1.42	27.02 ± 1.44	0.8763	NS
MMSE postoperative day 3	27.60 ± 0.84	27.70 ± 0.76	0.5781	NS
MMSE postoperative day 5	27.73 ± 0.75	27.75 ± 0.67	0.8755	NS
POCD: No	39 (97.5%)	38 (95.0%)	1.000	NS
POCD: Yes	1 (2.5%)	2 (5.0%)		

Discussion

Desflurane and sevoflurane are used volatile anaesthetic agents with favourable recovery profiles. Desflurane has a lower blood–gas partition coefficient and is eliminated more rapidly than sevoflurane, resulting in faster emergence. However, postoperative cognitive function after major cancer surgery is influenced by age, cognitive reserve, surgical stress, inflammation, pain, sleep disturbance and perioperative medications. Therefore, rapid anaesthetic elimination may not necessarily result in better postoperative cognition.

In the present study, desflurane was associated with earlier eye opening, shorter extubation time and earlier achievement of a Modified Aldrete Score greater than 9. Nevertheless, postoperative cognitive function assessed on days 1, 3 and 5, the incidence of postoperative cognitive dysfunction, and haemodynamic parameters were comparable between the desflurane and sevoflurane groups.

These findings are consistent with Rörtgen et al. [8] who reported faster emergence with desflurane but no significant difference in postoperative cognitive dysfunction, similarly Meineke et al. [9], observed transient MMSE reduction with both agents without a significant intergroup difference. Kuzminskaite et al. [10] found both agents equivalent regarding early cognitive function after thyroid surgery. Conversely, Saha et al. [11] reported better immediate cognitive recovery with desflurane. This discrepancy may reflect differences in cognitive assessment, as Saha et al. [11] used the Short Orientation Memory Concentration Test soon after extubation, whereas the present study used MMSE on postoperative days 1, 3 and 5. Qiao et al. [12] suggested that postoperative cognitive dysfunction is multifactorial and may be associated with perioperative inflammation and cerebral injury.

Thus, desflurane improves early recovery but does not provide a sustained cognitive advantage over sevoflurane.

Limitations

- The study used MMSE as the cognitive assessment tool. Although MMSE is simple and practical, it may not detect subtle changes in attention, executive function, processing speed or psychomotor performance. A larger neuropsychological battery would provide a more detailed assessment.
- This was a single-centre study with 40 patients in each group. More studies with larger group may be needed to generalize these findings.
- The follow-up period was limited to postoperative day 5; therefore, long-term neurocognitive outcomes could not be assessed.

Recommendations

- The patients should be followed up for a longer duration of period to access the post operative cognitive functions, as many of the reported cognitive outcomes have been reported after a duration of months.
- Detailed cognitive impairment tests like MoCA (Montreal Cognitve Assessment) and SOMCT (Short Orientation Memory Concentration Test) can be added to detect the minor cognitive impairments.

Conclusion

In the present study, desflurane resulted in earlier eye opening, earlier extubation and earlier achievement of Modified Aldrete score >9 when compared with sevoflurane. However, postoperative cognitive function assessed by MMSE and the incidence of POCD were statistically similar between the two groups. Therefore, we conclude that both desflurane and sevoflurane are comparable with respect to short-term postoperative cognitive outcomes in patients undergoing major cancer surgeries under general anaesthesia.

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