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ISOFLURANE V\S SEVOFLURANE EFFECT ON POST OPERATIVE COGNITIVE DYSFUNCTIONN IN ADULT PATIENTS UNDERGOING LAPROSCOPIC SURGERIES: A COMPARATIVE-CROSS SECTIONAL STUDY

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Abstract

Background: *Postoperative cognitive dysfunction (POCD) describes a decline in cognitive performance after surgery and anesthesia. Volatile anesthetic agents may differ in their recovery profiles and potential effects on cognition. This study compared postoperative cognitive test performance in adults receiving isoflurane or sevoflurane during laparoscopic surgery.*

Methods: *A comparative cross-sectional study was conducted in CDA Hospital, Islamabad, and DHQ Hospital, Bhakkar, from September to December 2024. One hundred adults aged 20–50 years with American Society of Anesthesiologists physical status I–II were included; 50 received isoflurane and 50 received sevoflurane. Postoperative cognition was assessed using the Trail Making Test, Controlled Oral Word Association Test, Letter Cancellation Test, Rey Auditory Test, and a perception test. Data were analyzed descriptively, with the thesis reporting selected group comparisons.*

Results: *The sample comprised 60 men (60%) and 40 women (40%); 72 (72%) were married and 87 (87%) were educated. Normal Trail Making Test performance was observed in 43/50 (86%) isoflurane patients and 47/50 (94%) sevoflurane patients; compromised performance occurred in 7 (14%) and 3 (6%), respectively (reported p=0.159). Normal verbal fluency was recorded in 38/50 (76%) and 45/50 (90%), while compromised fluency occurred in 12 (24%) and 5 (10%), respectively (p=0.054). Normal Letter Cancellation performance was 41/50 (82%) versus 43/50 (86%); mild compromise was 5 (10%) in each group, and marked compromise was 4 (8%) versus 2 (4%). Normal Rey Auditory performance was 33/50 (66%) versus 37/50 (74%); mild compromise was 7 (14%) versus 11 (22%), and marked compromise was 10 (20%) versus 2 (4%). Normal perception was recorded in 36/50 (72%) versus 43/50 (86%); mild compromise in 9 (18%) versus 6 (12%); and marked compromise in 5 (10%) versus 1 (2%) (reported p=0.052).*

Conclusion: *Across all five assessments, the sevoflurane group had a higher proportion of normal postoperative test performance. These descriptive findings suggest better early postoperative cognitive test*

performance with sevoflurane in this sample; however, the cross-sectional design, absence of reported preoperative baseline scores, and incomplete inferential statistics prevent a causal conclusion or a definitive determination of POCD incidence.

INTRODUCTION

Isoflurane and sevoflurane are volatile inhalational anesthetic agents used to maintain general anesthesia. Isoflurane is a stable, non-flammable agent with established clinical use, while sevoflurane is characterized by a relatively non-irritating profile and is commonly used for inhalational induction and maintenance (1). Differences in blood and tissue solubility influence anesthetic uptake, distribution, and emergence. These pharmacokinetic characteristics are relevant when considering postoperative recovery and the return of cognitive performance after general anesthesia [2,3].

Both agents produce anesthesia through effects on multiple neuronal membrane proteins and ion channels. Their actions involve central nervous system pathways associated with consciousness, memory, and responsiveness (4). Although the precise molecular mechanisms are complex, anesthetic exposure and metabolism may influence postoperative recovery (5). The pharmacology and metabolism of inhalational anesthetics therefore provide a biological rationale for examining whether different volatile agents are associated with differences in postoperative cognitive test performance [6,7].

Postoperative cognitive dysfunction has been used to describe cognitive changes after surgery, including difficulties with memory, attention, concentration, psychomotor performance, and executive function (8). Assessment generally requires structured neuropsychological testing because subtle changes may not be apparent during routine clinical observation (9). Cognitive impairment after surgery is multifactorial and may involve patient characteristics, surgical stress, inflammation, perioperative complications, and anesthetic exposure (11. 12). Previous literature has discussed associations between surgery, anesthesia, neuroinflammation, and cognitive decline [13, 14].

Age, pre-existing cognitive impairment, vascular or neurological disease, and perioperative complications have been identified as relevant risk factors in the broader literature (15, 16). Studies have also described relationships between mild cognitive impairment, delirium, and longer-term cognitive outcomes (17). The incidence and interpretation of postoperative cognitive change vary according to the population, timing of assessment, and neuropsychological instruments used (18, 19). These considerations make it important to define the study population and cognitive tests when comparing anesthetic techniques (20).

Previous research has examined emergence and recovery following different volatile anesthetics, including comparisons involving desflurane, isoflurane, and sevoflurane [21,22]. Experimental studies have also investigated cognitive effects associated with isoflurane and sevoflurane in animal models [23,24]. However, the thesis identifies a limited body of direct comparative evidence in adult patients undergoing laparoscopic surgery. The present study therefore compared postoperative cognitive performance among adults receiving isoflurane or sevoflurane, using tests of attention and coordination, verbal fluency, visuospatial scanning, memory and learning, and perception.

MATERIALS AND METHODS

A comparative cross-sectional study was conducted under the academic supervision of Bashir Institute of Health Sciences, Islamabad. The study was carried out at CDA Hospital, Islamabad, and DHQ Hospital, Bhakkar. The research period extended from September to December 2024, while the thesis reports that participant data were collected during October and November 2024.

The study population consisted of adults undergoing laparoscopic surgery under general anesthesia at the participating hospitals. A total sample of 100 patients was included, with 50 patients in the isoflurane group and 50 in the

sevoflurane group. The thesis describes the sample-size calculation using a 90% confidence level, a 5% margin of error, and an OpenEpi comparative-study calculation; the final selected sample was 100. Convenience and systematic sampling approaches were reported.

Eligible participants were 20–50 years old, had an ASA physical status of I or II, underwent laparoscopic surgery, and received isoflurane or sevoflurane for anesthetic maintenance. The reported induction and neuromuscular blocking agents included propofol, succinylcholine, rocuronium, and atracurium. Patients younger than 20 or older than 50 years, those with ASA physical status III–VI, patients undergoing cardiac surgery, and those receiving excluded anesthetic agents—including ketamine, thiopental, etomidate, pancuronium, vecuronium, desflurane, halothane, or nitrous oxide—were not included.

Postoperative cognitive performance was assessed in the postoperative care units using five tests: the Trail Making Test, Controlled Oral Word Association Test, Letter Cancellation Test, Rey Auditory Test, and a perception test. The Trail Making Test assessed attention and coordination by asking participants to connect digits in ascending order within 29 seconds. Verbal fluency was assessed by asking participants to produce a word beginning with the letter F within 15 seconds. The Letter Cancellation Test assessed visual scanning; the Rey Auditory Test assessed recall after a two-minute interval; and the perception test assessed recognition of objects in an image. Outcomes were categorized as normal, mildly compromised, or compromised where applicable, according to the criteria described in the thesis.

Permission was obtained from the institute, its institutional review board, and the participating hospital administrations before data collection. Informed consent was obtained from participants, and confidentiality was maintained by excluding identifiable patient details from the report. Questionnaire data were entered into Microsoft Excel and analyzed using IBM SPSS. The stated analyses included frequency distributions, descriptive statistics, one-way analysis of variance, and paired t-tests. The thesis also reports selected p-values for group comparisons; no additional inferential statistics have been generated for outcomes where values were not supplied.

RESULTS

A total of 100 patients were analyzed, comprising 50 patients who received isoflurane and 50 who received sevoflurane. Overall, 60 participants (60.0%) were male and 40 (40.0%) were female. Seventy-two participants (72.0%) were married, while 28 (28.0%) were unmarried. Eighty-seven participants (87.0%) were classified as educated and 13 (13.0%) as uneducated. The thesis does not provide a breakdown of these demographic characteristics by anesthetic group.

Table 1. Demographic characteristics of the study population (N=100)

Characteristic	Category	n	%
Gender	Male	60	60.0
	Female	40	40.0
Marital status	Married	72	72.0
	Unmarried	28	28.0
Education	Educated	87	87.0
	Uneducated	13	13.0

Attention and coordination were assessed using the Trail Making Test. In the isoflurane group, 43 of 50 patients (86.0%) completed the task within the specified time and were classified as normal, while 7 (14.0%) were classified as compromised. In the sevoflurane group, 47 patients (94.0%) were classified as normal and 3 (6.0%) as compromised. The thesis reports a p-value of 0.159 for this comparison.

Verbal fluency was assessed using the Controlled Oral Word Association Test. Normal performance was recorded in 38

patients (76.0%) in the isoflurane group and 45 patients (90.0%) in the sevoflurane group. Compromised performance was observed in 12 (24.0%) and 5 (10.0%) patients, respectively. The reported p-value was 0.054. The numerical difference favored sevoflurane, although the reported p-value did not meet the conventional 0.05 threshold.

Visuospatial scanning was evaluated using the Letter Cancellation Test. In the isoflurane group, 41 patients (82.0%) had normal performance, 5 (10.0%) had mildly compromised performance, and 4 (8.0%) were classified as compromised. In the sevoflurane group, 43 patients (86.0%) had normal performance, 5 (10.0%) had mildly compromised performance, and 2 (4.0%) were classified as compromised. A p-value for this comparison was not reported in the thesis.

Table 2. Postoperative cognitive test outcomes by anesthetic group

Test / outcome	Isoflurane (n=50)	Sevoflurane (n=50)	Reported p-value
Trail Making – normal	43 (86%)	47 (94%)	0.159
Trail Making – compromised	7 (14%)	3 (6%)	—
Verbal fluency – normal	38 (76%)	45 (90%)	0.054
Verbal fluency – compromised	12 (24%)	5 (10%)	—
Letter cancellation – normal	41 (82%)	43 (86%)	Not reported
Letter cancellation – mildly compromised	5 (10%)	5 (10%)	—
Letter cancellation – compromised	4 (8%)	2 (4%)	—
Rey auditory – normal	33 (66%)	37 (74%)	Not reported
Rey auditory – mildly compromised	7 (14%)	11 (22%)	—
Rey auditory – compromised	10 (20%)	2 (4%)	—
Perception – normal	36 (72%)	43 (86%)	0.052
Perception – mildly compromised	9 (18%)	6 (12%)	—
Perception – compromised	5 (10%)	1 (2%)	—

Memory and learning were assessed using the Rey Auditory Test. Normal performance was observed in 33 patients (66.0%) receiving isoflurane and 37 (74.0%) receiving sevoflurane. Mildly compromised performance occurred in 7 (14.0%) and 11 (22.0%), respectively, while compromised performance was recorded in 10 (20.0%) and 2 (4.0%). Thus, the proportion with markedly compromised recall was higher in the isoflurane group, whereas mild compromise was more frequent in the sevoflurane group.

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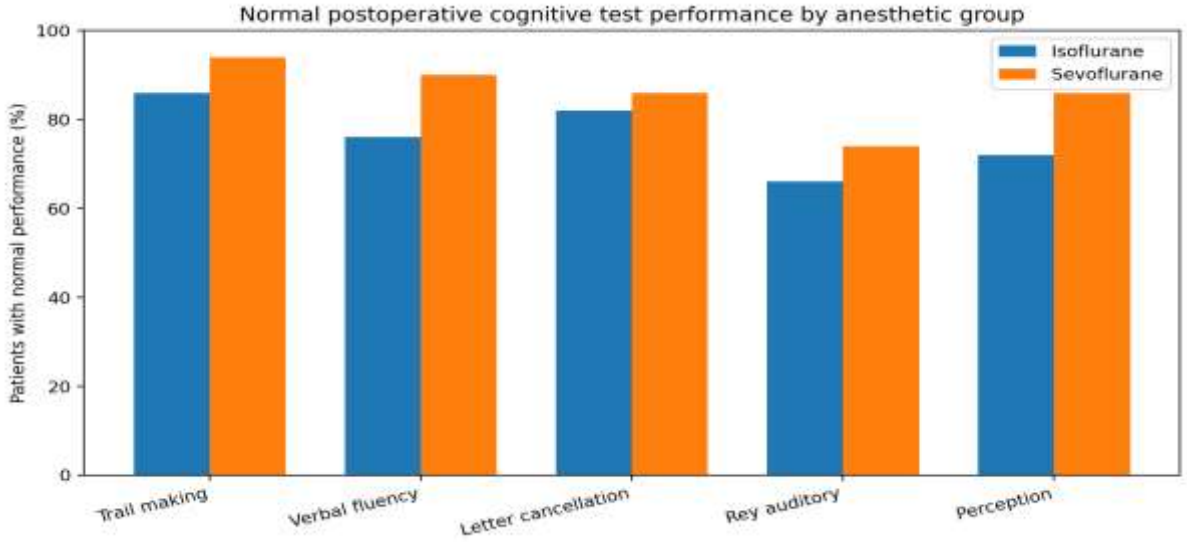


Figure 1. Percentage of patients with normal performance across the five postoperative cognitive assessments.

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Perception was assessed by asking participants to identify objects in a displayed image. Normal perception was recorded in 36 patients (72.0%) in the isoflurane group and 43 (86.0%) in the sevoflurane group. Mildly compromised perception occurred in 9 (18.0%) and 6 (12.0%), while compromised perception occurred in 5 (10.0%) and 1 (2.0%), respectively. The thesis reports a p-value of 0.052 for this comparison.

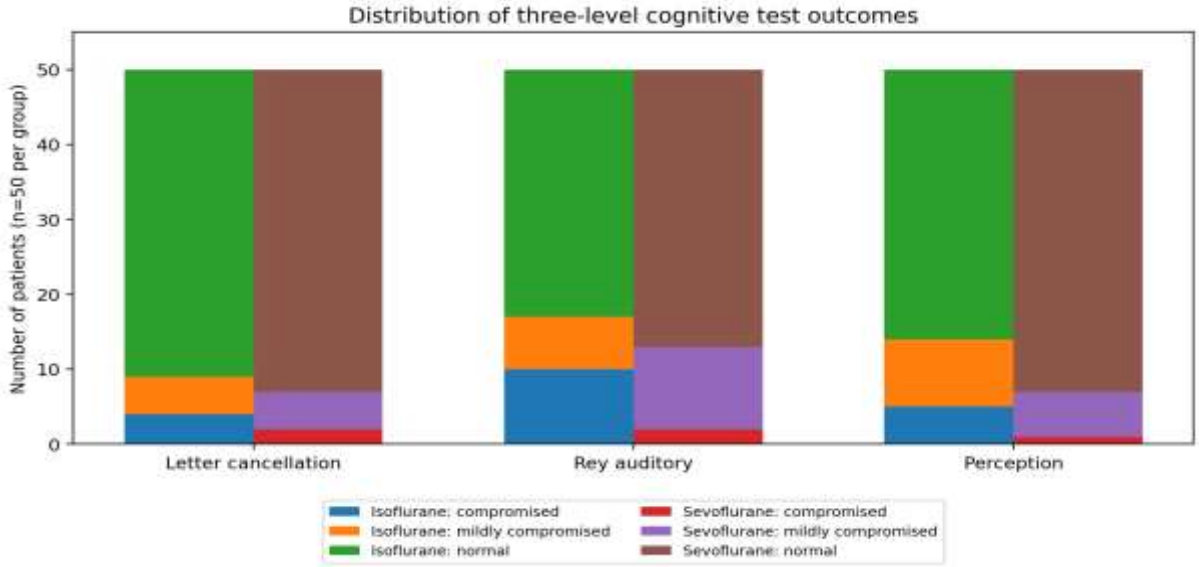


Figure 2. Distribution of normal, mildly compromised, and compromised outcomes in the three assessments using three outcome categories. Each group included 50 patients.

Across all five assessments, the proportion of patients classified as having normal performance was numerically higher in the sevoflurane group: 94% versus 86% for Trail Making, 90% versus 76% for verbal fluency, 86% versus 82% for Letter Cancellation, 74% versus 66% for Rey Auditory recall, and 86% versus 72% for perception. These are descriptive comparisons. The source thesis does not provide complete test statistics, confidence

intervals, or p-values for every outcome, and no overall composite POCD rate is reported.

DISCUSSION

This comparative cross-sectional study examined postoperative cognitive test performance in 100 adults undergoing laparoscopic surgery, with equal numbers receiving isoflurane and sevoflurane. Across each of the five cognitive assessments, the proportion of patients with normal performance was higher in the sevoflurane group. The largest absolute differences in normal performance were observed for verbal fluency and perception, each with a 14-percentage-point difference, followed by Trail Making (8 points), Rey Auditory recall (8 points), and Letter Cancellation (4 points). These findings describe the observed sample and should not be interpreted as proof that one agent caused less cognitive dysfunction.

The Trail Making results showed normal performance in 86% of the isoflurane group and 94% of the sevoflurane group. The thesis reports p=0.159, which does not establish a statistically significant between-group difference at the conventional 0.05 level. This is important because the discussion in the original thesis characterizes the result as significant and gives a different p-value in one passage. The tabulated result (0.159) has been retained in this article as the primary reported value. Research on postoperative cognition emphasizes the importance of standardized definitions and careful interpretation of neuropsychological outcomes [9,19].

Verbal fluency was normal in 76% of patients receiving isoflurane and 90% receiving sevoflurane, with a reported p-value of 0.054. Similarly, normal perception was observed in 72% and 86%, respectively, with a reported p-value of 0.052. Both comparisons show numerical differences favoring sevoflurane, but the reported p-values are slightly above 0.05. The Letter Cancellation and Rey Auditory results also favored sevoflurane in terms of normal performance, although inferential statistics were not supplied for these outcomes. Consequently, the data support a consistent descriptive pattern but not a definitive statistical claim across all domains.

Prior literature has proposed several mechanisms through which surgery and anesthesia may be associated with postoperative cognitive changes, including neuroinflammation, oxidative stress, altered neuronal signaling, and changes in synaptic function [10,13–16]. Experimental studies have examined cognitive effects of isoflurane and sevoflurane in animal models, including effects on neurogenesis and inflammatory pathways [23,24]. Such findings provide biological context but cannot be directly extrapolated to clinical outcomes in adult surgical patients. Clinical cognitive outcomes are also influenced by age, baseline cognition, comorbidities, surgical factors, and the timing and sensitivity of postoperative testing [11,17–20].

The findings are broadly consistent with the study's stated objective of comparing postoperative cognitive performance between the two volatile agents. However, the study did not report preoperative cognitive scores, the exact interval between anesthesia and cognitive testing, group-specific baseline characteristics, anesthetic concentrations or exposure duration, or confidence intervals. Without baseline testing, a postoperative low score cannot confidently be attributed to a decline from the patient's preoperative state. The term POCD should therefore be interpreted cautiously: the present data represent postoperative test classifications rather than a validated incidence estimate of new-onset POCD. Larger prospective studies with baseline and serial follow-up testing are needed.

CONCLUSION

In this sample of 100 adults undergoing laparoscopic surgery, patients who received sevoflurane had a higher proportion of normal performance than those who received isoflurane across all five postoperative cognitive assessments. The descriptive differences ranged from 4 to 14 percentage points. The reported p-values for Trail Making (0.159), verbal fluency (0.054), and perception (0.052) did not reach the conventional threshold for statistical significance. The findings suggest a possible advantage for sevoflurane in early postoperative cognitive test performance, but they do not

establish a causal effect or confirm a lower incidence of POCD.

LIMITATIONS

The study was limited by its cross-sectional design, modest sample size, convenience and systematic sampling, and inclusion of patients from only two hospitals. The thesis does not report preoperative cognitive baseline measurements, detailed group-wise demographic or clinical characteristics, the precise timing of postoperative testing, anesthetic exposure concentrations or duration, confidence intervals, or complete p-values for all cognitive outcomes. No validated composite definition or overall incidence of POCD was provided. In addition, one p-value in the original discussion differs from the value in the results table; the tabulated value of 0.159 was used for Trail Making in this article.

RECOMMENDATIONS

Future research should use a prospective randomized design with adequate sample-size justification, standardized anesthetic protocols, and preoperative cognitive assessment followed by repeated postoperative evaluations at clearly defined intervals. Validated neuropsychological instruments and a prespecified definition of postoperative neurocognitive disorder should be used. Studies should report baseline comparability, anesthetic dose and duration, effect sizes, confidence intervals, and complete statistical tests for every outcome. Until stronger evidence is available, the present findings should be considered preliminary and should not alone determine the choice of volatile anesthetic for an individual patient.

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