Incidence of Postoperative Delirium in Geriatric Patients Undergoing General Anaesthesia Using Either Sevoflurane or Propofol

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ABSTRACT

Objective: To compare the incidence of postoperative delirium (POD) in geriatric patients undergoing elective surgeries under general anaesthesia using either propofol or sevoflurane.

Study Design: Randomised controlled trial (RCT).

Place and Duration of the Study: Department of Anaesthesia, Allied Hospital, Faisalabad, Pakistan, from December 2024 to May 2025.

Methodology: A total of 200 patients aged between 65 and 90 years undergoing elective moderate-risk surgeries under general anaesthesia were included through a non-probability consecutive sampling technique. Patients were randomly assigned to Group A (sevoflurane) or Group B (propofol) using sealed envelopes. Delirium was assessed using the confusion assessment method (CAM) criteria twice daily for the first seven days following surgery. Data were recorded on a structured proforma and analysed using SPSS version 26. Statistical analysis was performed using the Chi-square test to compare the incidence of POD. A value of $p < 0.05$ was considered statistically significant.

Results: POD was identified in 13.0% of patients in Group A compared to 4.0% in Group B, showing a statistically significant difference ($p = 0.022$). Higher rates of delirium were also significantly associated with ASA I patients ($p = 0.020$) and those undergoing spine surgeries ($p = 0.037$).

Conclusion: Propofol was associated with a significantly lower incidence of POD compared to sevoflurane in geriatric patients, suggesting preferential use of propofol in geriatric patients.

Key Words: *Delirium, Propofol, Sevoflurane, Geriatric patients, General anaesthesia, Confusion assessment method criteria*.

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INTRODUCTION

Among postoperative complications, delirium is notably common,[1,2] particularly in the geriatric population, which constitutes approximately one-third of surgical cases.[3,4] This condition typically occurs within seven days after surgery and is defined by fluctuating levels of attention, awareness, and mental clarity. The reported incidence of postoperative delirium (POD) ranges from 2 to 24%, with a higher tendency observed in geriatric patients.[5] The impact of POD includes significantly prolonged hospital stays, cognitive and functional deterioration, a heightened risk of Alzheimer's disease and related dementias, and increased mortality. Individuals with dementia are 2.5 to 4.7 times more prone to develop delirium, and delirium itself is associated with a 12.5-fold rise in newly diagnosed Alzheimer's disease and related conditions.[6]

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POD also leads to increased medical costs, a greater likelihood of nursing home admission, higher morbidity and mortality, and emotional and physical strain on patients and their families.[7-10]

The underlying causes of POD remain uncertain. It does not appear to stem from oxygen deprivation or reduced blood flow to the brain, and its incidence is similar under general and regional anaesthesia. Current theories suggest that ischaemia, hypoxaemia, inflammation from surgical trauma, or stress hormone release may be involved.[11] The exact pathophysiology of delirium is still not fully understood, although current theories primarily focus on neurotransmitter imbalances and neuroinflammation. Common triggering factors include the use of sedative-hypnotic medicines, anaesthesia, surgical procedures, pain, anaemia, infections, acute medical conditions, and flare-ups of chronic diseases.[3]

In modern anaesthetic practice, both propofol total intravenous anaesthesia (TIVA) and sevoflurane (inhalation) are widely utilised for maintaining anaesthesia during surgery. Propofol is associated with lower risks of postoperative nausea and vomiting, minimal environmental contamination, and a decreased likelihood of inducing malignant hyperthermia. Conversely, sevoflurane offers benefits such as bronchodila-

tion, ischaemic protection before and after surgery, cost-effectiveness, and ease of administration.[12] Since anaesthetics primarily target the brain, they may contribute to the development of POD. The neurological effects of propofol and sevoflurane are still not well defined. While some experimental evidence suggests that sevoflurane offers neuroprotection against cerebral injury, other findings indicate possible neurotoxic effects. Propofol has similarly been shown to exhibit both protective and harmful effects on the brain in various studies. Although most general anaesthetics act on GABA-A receptors, the mechanisms of propofol and sevoflurane in the brain may differ. This could explain the variation in their impact on POD, with 15.7% of patients experiencing POD after sevoflurane use *versus* only 5% with propofol.[13]

As geriatric patients are particularly vulnerable to POD and standardised anaesthetic protocols remain underdeveloped in regions such as Pakistan, it is essential to identify which anaesthetic agent is associated with a reduced risk of delirium in this population.

This study aimed to compare the incidence of POD in geriatric patients undergoing elective surgeries under general anaesthesia using either propofol or sevoflurane.

METHODOLOGY

This randomised controlled trial (RCT) was conducted at the Department of Anaesthesia, Allied Hospital, Faisalabad, Pakistan, from December 2024 to May 2025, following ethical approval from the hospital's Ethical Review Committee (ERC No: 48.ERC/FMU/2023-24/546; Dated 5.12.2024). The study was prospectively registered with the Iranian Registry of Clinical Trials (IRCT) under the registration number (IRCT20250524065864N1). A sample size of 200 patients (100 in each group) was calculated using the WHO sample size calculator, based on an expected delirium incidence of 5% in the Propofol group (Group B) and 15.7% in the Sevoflurane group (Group A), with 80% power and a 5% level of significance.

Inclusion criteria included patients of either gender aged between 65 and 90 years, scheduled for elective mild-to-moderate risk surgeries (such as spine, general [including inguinal] or orthopaedic procedures) under general anaesthesia, and classified as American Society of Anaesthesiologists (ASA) physical status I to III. Surgical procedures included paraumbilical and incisional hernia repairs and laparoscopic cholecystectomy under general surgery, lumbar decompression and spinal fusion under spine surgery, total knee replacement (TKR) and total hip replacement (THR) under orthopaedics, and transurethral resection of the prostate (TURP) under urology. Patients were excluded if they had preoperative delirium, a documented history of dementia, or psychiatric/neurological disorders such as schizophrenia, epilepsy, Parkinson's disease, or myasthenia gravis, hepatic or renal dysfunction, recent surgery within six months, postoperative mechanical ventilation requirement, or allergy to the study medication.

Subjects who fulfilled the eligibility requirements and consented to participate were randomly divided into two equal groups using computer-generated random numbers. Group A received sevoflurane-based anaesthesia, while Group B received propofol-based anaesthesia. Anaesthesia in Group A was induced with sevoflurane *via* inhalation using a 6–8% concentration in 100% oxygen. Anaesthesia was maintained with 1–3% sevoflurane, titrated to a bispectral index (BIS) value between 40 and 60.

Group B participants were induced with intravenous propofol (1–2 mg/kg), nalbuphine (0.1–0.2 mg/kg), and atracurium (0.5 mg/kg), and received a target-controlled infusion (TCI) of propofol to maintain a BIS value within the same range. Muscle relaxation in both groups was maintained with continuous atracurium infusion (10 µg/kg/min). Postoperatively, all patients were transferred to the post-anaesthesia care unit (PACU).

Delirium was assessed using the confusion assessment method (CAM) criteria twice daily (between 8–10 a.m. and 6–8 p.m.) for the first seven postoperative days. The CAM diagnostic criteria required the presence of an acute onset and a fluctuating course, with inattention, and either disorganised thinking or an altered level of consciousness. A diagnosis of delirium required the presence of features 1 and 2, and either 3 or 4. All assessments were performed by the principal investigator (PI) and trained clinical staff, blinded to group allocation under the supervision of the PI. Patients were evaluated in person while at the hospital, and if discharged before day 7, were followed up *via* telephone to continue their CAM assessment.

Data were analysed using SPSS version 26. Quantitative variables, such as age, were expressed as mean ± standard deviation, while qualitative variables, such as gender, ASA status, type of surgery, comorbidities, and delirium incidence, were presented as frequencies and percentages. Chi-square test was used when all expected cell frequencies were ≥5, whereas Fisher's exact test was used when any expected cell frequency was <5. For the primary outcome comparison, the p-value was calculated for the 'Delirium present' category. Statistical significance was set at $p < 0.05$.

RESULTS

Baseline demographic and clinical characteristics in total and among both groups are shown in Table I. The mean age of all patients was 75.2 ± 9.3 years. The gender distribution was nearly equal between the two groups. In the Sevoflurane group, there were 51 (51.0%) males and 49 (49.0%) females. Conversely, the Propofol group had 47 (47.0%) males and 53 (53.0%) females. Collectively, there were 98 (49.0%) males and 102 (51.0%) females in the study. In the Sevoflurane group, 23 (23.0%) were ASA I, 44 (44.0%) ASA II, and 33 (33.0%) ASA III. In the Propofol group, 22 (22.0%) were ASA I, 46 (46.0%) ASA II, and 32 (32.0%) ASA III. Overall, the majority of participants belonged to ASA II (45.0%), followed by ASA III (32.5%) and ASA I (22.5%).

Table I: Demographic and clinical characteristics (n = 200).

Variables	Groups	Sevoflurane (n = 100) (Count, %)	Propofol (n = 100) (Count, %)	Total (Count, %)
Age (years)	Mean ± SD	76.11 ± 9.12	74.28 ± 9.38	75.20 ± 9.27
BMI	Mean ± SD	27.02 ± 4.84	26.68 ± 4.88	26.85 ± 4.85
Gender	Male	51 (51.0%)	47 (47.0%)	98 (49.0%)
	Female	49 (49.0%)	53 (53.0%)	102 (51.0%)
ASA status	I	23 (23.0%)	22 (22.0%)	45 (22.5%)
	II	44 (44.0%)	46 (46.0%)	90 (45.0%)
	III	33 (33.0%)	32 (32.0%)	65 (32.5%)
Comorbidities	Hypertension	29 (29.0%)	28 (28.0%)	57 (28.5%)
	Diabetes	32 (32.0%)	24 (24.0%)	56 (28.0%)
	Cardiovascular disease	19 (19.0%)	27 (27.0%)	46 (23.0%)
	None	20 (20.0%)	21 (21.0%)	41 (20.5%)
Surgery types	Spine	27 (27.0%)	21 (21.0%)	48 (24.0%)
	General (including inguinal)	29 (29.0%)	71 (71.0%)	59 (29.5%)
	Orthopaedic	27 (27.0%)	25 (25.0%)	52 (26.0%)
Duration of surgery (minutes)	Mean ± SD	36.90 ± 4.82	37.43 ± 4.64	37.17 ± 4.73

Table II: Frequency of delirium in the two groups (n = 200).

Delirium	Group A (Sevoflurane)	Group B (Propofol)	Total	p-value[a]
Yes	13 (13.0%)	4 (4.0%)	17 (8.5%)	0.022
No	87 (87.0%)	96 (96.0%)	183 (91.5%)	

[a]*Fisher's exact test (applied due to expected cell frequency <5)*.

Surgical procedures were categorised into spine, orthopaedic, and general (including inguinal hernia repair) surgeries. Overall, general surgeries were the most frequent (50%), followed by orthopaedic surgeries (26.0%) and spine surgeries (24.0%, Table I). The comorbidity profile revealed varied distributions, as shown in Table I. Collectively, the most prevalent condition was hypertension (28.5%), followed by diabetes (28.0%) and cardiovascular diseases (23.0%).

The mean body mass index (BMI) for the Sevoflurane group was 27.02 ± 4.84 kg/m^2, while for the Propofol group it was 26.68 ± 4.88 kg/m^2. The average duration of surgery was 36.90 ± 4.82 minutes in the Sevoflurane group and 37.43 ± 4.64 minutes in the Propofol group.

Table II compares the frequency of POD between the two anaesthesia groups. Delirium occurred in 13.0% of patients in Group A and in only 4.0% in Group B ($p = 0.022$). The total incidence of delirium was 8.5% across the study population.

Secondary analysis revealed significant associations between anaesthetic type and POD in specific surgical procedures. Among spine surgery patients, all five cases of delirium occurred exclusively in Group A ($p = 0.037$). No significant associations were observed for general surgery ($p = 0.612$) or orthopaedic procedures ($p = 0.936$).

Overall, delirium showed statistically significant associations with anaesthesia type, ASA I status, specific surgery types (spine), and predominantly affected patients in the Sevoflurane group.

DISCUSSION

This RCT assessed the comparative incidence of POD in geriatric patients receiving either sevoflurane- or propofol-based anaesthesia. The demographic profile of the study cohort, with a mean age of 75.20 ± 9.27 years and a nearly equal gender distribution (49% male, 51% female), aligns well with several recent studies evaluating POD in geriatric surgical patients. For example, Zhao *et al*. reported an average patient age of approximately 75 years in a cohort of 120 geriatric patients undergoing surgery for malignant tumours, also with a balanced gender distribution.[13]

Additionally, the RAPID-II trial protocol described by Taschner *et al*. enrolled patients aged ≥65 years undergoing moderate- to high-risk major non-cardiac surgery, with careful stratification based on ASA physical status and comorbidities, comparable to the inclusion of ASA I–III patients in the present study.[14] El Kerdasy *et al*. in a retrospective study of 200 geriatric patients, also reported comparable ASA distributions and identified ASA III and diabetes as the significant correlates of POD, which were examined as effect modifiers in this analysis.[15]

Furthermore, the study by Zhao *et al*. highlighted the use of the CAM for ICU (CAM-ICU) and monitoring of parameters such as BIS, mean arterial pressure (MAP), and heart rate, practices consistent with perioperative and postoperative protocols employed in the current study.[13] Such alignment in methodology across studies supports the robustness and relevance of these findings in the broader clinical context.

The findings revealed a significantly higher incidence of POD in the Sevoflurane group compared to the Propofol group, supporting the hypothesis that anaesthetic choice influences the development of delirium in geriatric surgical patients. These findings are supported by several studies that favour propofol over sevoflurane in minimising the incidence of POD. Notably, El Kerdasy *et al*. retrospectively analysed 200 geriatric patients and found a significantly higher POD inci-

dence in patients receiving sevoflurane (14%) compared to propofol (30%, p <0.05).[15] They also reported associations between the POD and ASA status, diabetes, and anaesthetic type, aligning with the present findings of significant associations with ASA I patients. Cao *et al*.,[4] in a large multicentre randomised trial involving 1,195 geriatric patients undergoing major cancer surgery, demonstrated a lower POD incidence in the Propofol group (8.4%) compared to Sevoflurane group (12.4%), with an adjusted relative risk of 0.59 (p = 0.014). The data suggest a trend toward lower early POD in the Propofol group, though specific day-wise analysis was not part of the initial design.

Chang *et al*.[12] examined geriatric patients undergoing spine surgery and identified a clear link between anaesthetic type and POD, consistent with stratified findings where spine surgeries showed significantly higher POD rates in the sevoflurane group. Additionally, Khan *et al*.[6] indirectly supported the neurocognitive benefits of propofol over other sedative regimens, showing reduced delirium when propofol was used over dexmedetomidine in cardiac surgery. Although not a direct comparison with sevoflurane, it suggests a favourable cognitive profile of propofol.

In contrast, several studies offer differing or inconclusive findings regarding the comparative effects of sevoflurane and propofol. Mei *et al*.[5] reported a higher and prolonged POD in patients receiving propofol (33%) compared to sevoflurane (23.3%), though the difference in incidence was not significant (p = 0.119). The duration of delirium, however, was significantly longer with propofol (p = 0.049), highlighting the need to assess both incidence and persistence of delirium. Reddy and Umapathy found no significant difference in POD incidence between the two anaesthetic agents in a study involving geriatric patients undergoing total knee replacement/total hip replacement (TKR/THR).[16] However, they noted a shorter duration of POD with sevoflurane, aligning with Mei *et al*.'s findings regarding delirium persistence.[5] Zhou *et al*., in an observational study of Parkinson's disease patients undergoing deep brain stimulation surgery, found no significant difference in POD incidence between the propofol (22.2%) and sevoflurane (21.0%, p = 0.865).[13] This suggests that baseline neurological vulnerabilities may diminish the differential effects of anaesthetic agents on POD.

Overall, the literature presents mixed findings. This data corroborate findings from prior studies favouring propofol, especially in general geriatric surgical populations without neurological comorbidities. Variability in outcomes across studies may stem from differences in patient selection, surgical type, anaesthetic monitoring, and comorbid burden. This study adds to the evidence base by providing data from an RCT in a South Asian context, an underrepresented region in anaesthetic delirium literature. Future multicentre trials with stratified analyses by surgery type and comorbidity status are warranted to validate these findings and guide anaesthetic selection for geriatric patients.

CONCLUSION

This RCT demonstrates that geriatric patients receiving sevoflurane-based anaesthesia exhibit a significantly higher incidence of POD compared to those receiving propofol-based anaesthesia. The findings align with several contemporary studies favouring propofol, especially in geriatric patients undergoing elective surgeries without neurological comorbidities. Although these findings reinforce a connection between anaesthetic agent and delirium risk, their applicability is confined to the demographic, clinical, and procedural parameters of this study. The data indicate that propofol might be a more suitable anaesthetic for older adults, aiming to lower the incidence of POD. Further large-scale, multicentre research in this population is highly recommended to refine these associations and guide clinical protocols in diverse healthcare settings.

ETHICAL APPROVAL:
This study was conducted after obtaining ethical approval from the Ethical Review Committee of Faisalabad Medical University, Faisalabad, Pakistan (ERC No. 48.ERC/FMU/2023-24/546; Dated 5.12.2024).

PATIENTS' CONSENT:
Written informed consent was obtained from all participants included in the study.

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
MIK: Conceptualisation, study design, and manuscript writing, data collection, patient follow-up, statistical analysis, and result interpretation.
HA: Critical revision of the manuscript.
Both authors approved the final version of the manuscript to be published.

REFERENCES

1. Urban MK, Sasaki M, Schmucker AM, Magid SK. Postoperative delirium after major orthopaedic surgery. *World J Orthop* 2020; **11(2)**:90-106. doi: 10.5312/wjo.v11.i2.90.
2. Heo SC, Ahn HS, Shin R, Lim CS, Han DS. Risk factors of elderly patients with postoperative delirium following major abdominal surgery for cancer. *Korean J Clin Oncol* 2020; **16(2)**:104-9. doi: 10.14216/kjco.20016.
3. Pipanmekaporn T, Punjasawadwong Y, Wongpakaran N, Wongpakaran T, Suwannachai K, Chittawatanarat K, *et al*. Risk factors and adverse clinical outcomes of postoperative delirium in Thai elderly patients: A prospective cohort study. *Perspect Psychiatr Care* 2021; **57(3)**:1073-82. doi: 10.1111/ppc.12658.
4. Cao SJ, Zhang Y, Zhang YX, Zhao W, Pan LH, Sun XD, *et al*. Delirium in older patients given propofol or sevoflurane anaesthesia for major cancer surgery: A multicentre randomised trial. *Br J Anaesthesia* 2023; **131(2)**:253-65. doi: 10.1016/j.bja.2023.04.024.

5. Mei X, Zheng H, Li C, Ma X, Zheng H, Marcantonio E, *et al*. The effects of propofol and sevoflurane on postoperative delirium in older patients: A randomised clinical trial study. *J Alzheimers Dis* 2020; **76(4)**:1627-36. doi: 10.3233/JAD-200322.
6. Khan MA, Usman M, Hussain I, Shah SN, Khattav O, Haq BU, *et al*. Propofol *versus* dexmedetomidine sedation reduces delirium after cardiac surgery. *J Gandhara Med Dent Sci* 2023; **10(2)**:92-6. doi: 10.37762/jgmds.10-2.372.
7. Mendez-Martinez C, Fernandez- Martinez MN, Garcia-Suarez M, Martinez-Isasi S, Fernandez-Fernandez JA, Fernandez-Garcia D. Related factors and treatment of postoperative delirium in old adult patients: An integrative review. *Healthcare (Basel)* 2021; **9(9)**:1103. doi: 10.3390/healthcare9091103.
8. Albanese AM, Ramazani N, Greene N, Bruse L. Review of postoperative delirium in geriatric patients after hip fracture treatment. *Geriatr Orthop Surg Rehabil* 2022; **13**:21514593211058947. doi: 10.1177/21514593211058947.
9. Williams ST, Dhesi JK, Partridge JSL. Distress in delirium: Causes, assessment and management. *Eur Geriatr Med* 2020; **11(1)**:63-70. doi: 10.1007/s41999-019-00276-z.
10. El-Hadi SM, Abd Alkader AAZ, Abo Elwafa RAH, Mohamed ED, Abdel Azim RAE. Effect of sevoflurane *versus* propofol on early cognitive functions in elderly patients after lumbar disc surgery. *Egyptian J Anaesthesia* 2024; **40(1)**:61-8. doi: 10.1080/11101849.2023.2281794.
11. Zhou Y, Li Z, Ma Y, Yu C, Chen Y, Ding J, *et al*. The effect of propofol *versus* sevoflurane on postoperative delirium in Parkinson's disease patients undergoing deep brain stimulation surgery: An observational study. *Brain Sci* 2022; **12(6)**:689. doi: 10.3390/brainsci12050689.
12. Chang JE, Min SW, Kim H, Won D, Lee JM, Kim TK, *et al*. Association between anaesthetics and postoperative delirium in elderly patients undergoing spine surgery: Propofol *versus* sevoflurane. *Global Spine J* 2024; **14(2)**:478-84. doi: 10.1177/21925682221110828.
13. Zhao S, Lu Y, Zhuang X. The effects of propofol and sevoflurane on postoperative delirium in patients with malignant tumours. *Indian J Pharmaceut Sci* 2019; **81(1)**:138-43.
14. Taschner A, Fleischmann E, Kabon B, Sinner B, Eckhardt C, Horvath K, *et al*. Effect of desflurane, sevoflurane or propofol on the incidence of postoperative delirium in older adults undergoing major non-cardiac surgery: Protocol for the RAPID-II trial. *BMJ Open* 2024; **14(11)**:e092611. doi: 10.1136/bmjopen-2024-092611.
15. El Kerdasy YAA, Fadl Mahmoud I, Abdmokhles Abdelmottaleb N, Montasser Ali MG, Helmy Elsaied M. Anaesthetics and postoperative delirium in elderly after elective surgery: A retrospective comparison between sevoflurane and propofol. *Med J Islam Repub Iran* 2025; **39**:7. doi: 10.47176/mjiri.39.7.
16. Reddy KRK, Umapathy P. Analysis between propofol and sevoflurane in causing postoperative delirium in geriatric patients. *Int J Pharm Clin Res* 2023; **15(6)**:2298-308.