Section: Anaesthesia

Original Research Article

PROSPECTIVE ASSESSMENT OF COGNITIVE FUNCTION AFTER GENERAL ANAESTHESIA IN ELDERLY SURGICAL PATIENTS

Rajat Garg[1], Geetesh Kumar[1], Shubhi Singh[2], Ajay Kumar[2]

[1]*Associate Professor, NC medical College, Israna, Panipat, Haryana, India*
[2]*Assistant Professor, NC medical College, Israna, Panipat, Haryana, India*

Received : *12/02/2025*
Received in revised form : *02/04/2025*
Accepted : *17/04/2025*

Corresponding Author:
Dr. Ajay Kumar,
Assistant Professor, Nc medical College, Israna, Panipat, Haryana, India.
Email: ajaykumar0808@gmail.com

DOI: 10.70034/ijmedph.2025.2.148

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (2); 823-828

ABSTRACT

Background: The aim is to prospectively assess cognitive function and the incidence of postoperative cognitive dysfunction (POCD) in elderly patients undergoing elective non-cardiac surgery under general anaesthesia, and to identify associated risk factors.

Materials and Methods: This prospective observational study was conducted over 12 months at a tertiary care hospital. Ninety patients aged ≥65 years, scheduled for elective non-cardiac surgery under general anaesthesia, were enrolled. Patients were assessed for cognitive function using the Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) at four time points: preoperatively (baseline), and postoperatively on Day 1, Day 3, and Day 7. Data on demographics, comorbidities, ASA grade, type and duration of surgery, and anaesthetic details were collected. Statistical analysis was performed using SPSS version 25.0, with $p < 0.05$ considered significant.

Results: The mean preoperative MMSE and MoCA scores were 27.4 ± 1.9 and 25.1 ± 2.4, respectively. On postoperative Day 1, both scores declined significantly (MMSE: 24.8 ± 2.3, MoCA: 21.7 ± 2.6; $p < 0.001$), with gradual improvement by Day 7. POCD was present in 37.78% of patients on Day 1, declining to 10.00% by Day 7. Significant risk factors for POCD included older age ($p = 0.014$), ASA grade III ($p = 0.002$), longer surgery duration ($p = 0.008$), hypertension ($p = 0.019$), and diabetes mellitus ($p = 0.012$).

Conclusion: Elderly patients undergoing general anaesthesia for elective non-cardiac surgery are at notable risk for early POCD, particularly within the first 24–72 hours. Cognitive decline is largely transient, but risk increases with age, comorbidities, and higher ASA status. Preoperative cognitive screening and tailored perioperative strategies are essential to mitigate POCD risk in this population.

Keywords: Postoperative Cognitive Dysfunction, General Anaesthesia, Elderly, MMSE, MoCA.

INTRODUCTION

Postoperative cognitive dysfunction (POCD) is a well-documented complication following surgery and anaesthesia, particularly among the elderly. It refers to a measurable decline in cognitive performance, including impairments in memory, attention, executive functioning, and psychomotor speed. While often transient, POCD can persist in some individuals and may negatively impact recovery, functional independence, and overall quality of life in the postoperative period. As the global population ages and the number of elderly patients undergoing surgery increases, the clinical significance of POCD continues to grow, warranting further research into its incidence, risk factors, and pathophysiology. General anaesthesia has been considered a contributing factor to the development of POCD, especially in elderly patients who may already have underlying cognitive vulnerability or subclinical neurodegenerative changes. Cognitive decline following anaesthesia has been observed across various surgical contexts, with non-cardiac and cardiac surgeries both demonstrating measurable postoperative neurocognitive effects. The elderly are especially susceptible due to age-related structural and functional brain changes, reduced cognitive reserve, and a higher prevalence of comorbidities, including cardiovascular and metabolic diseases.[1,2]

Several large-scale studies have indicated that patients undergoing major non-cardiac surgery under general anaesthesia are at increased risk of developing POCD, particularly within the first few days to weeks after the procedure.[1-3] These impairments may be reversible in most cases; however, long-term consequences including persistent cognitive deficits and even increased risk of developing dementia have been reported in some cohorts.[3,4] The relationship between anaesthetic technique and cognitive outcomes remains complex, with variables such as anaesthetic agent used, intraoperative hemodynamic stability, and patient-specific factors all contributing to cognitive trajectories postoperatively.

Evidence has shown that even subtle perioperative disturbances such as hyperthermia may increase the risk of cognitive impairment postoperatively.[5,6] In addition, the type of surgery, duration of anaesthesia, postoperative pain, sleep disturbances, and emotional stress have all been linked to the occurrence of POCD. While the phenomenon has often been associated with cardiac surgeries, recent studies emphasize that non-cardiac surgical interventions, too, carry a substantial risk for cognitive decline in the elderly.[2,6]

Neuropsychological tools such as the Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), and other specialized tests like DemTect and the Rivermead Behavioural Memory Test have been used to detect and quantify cognitive changes following surgery.[7,8] These assessments allow clinicians and researchers to monitor patients longitudinally and detect early signs of cognitive deterioration. The use of such tools in clinical studies has provided valuable insights into the patterns and timing of cognitive recovery or deterioration following surgery and anaesthesia.

Recent observational studies have further refined our understanding of POCD by examining specific patient populations, such as individuals at high risk for obstructive sleep apnea (OSA), and comparing different anaesthetic regimens. Interestingly, some studies have reported that patients with suspected OSA may demonstrate a lower incidence of POCD, possibly due to underlying physiological adaptations or the type of anaesthesia used.[9,10] These findings open new avenues for exploring how pre-existing conditions and individual patient profiles may modulate postoperative cognitive outcomes.

Cardiac surgery patients have particularly been studied due to their higher susceptibility to POCD and other neurological complications. Studies involving patients undergoing coronary artery bypass grafting (CABG) have shown significant long-term cognitive decline, with evidence of persistent impairment even after 7.5 years post-surgery.[11-13] These results raise concerns about the potential neurotoxic effects of anaesthetic agents and the impact of surgical stress and systemic inflammation on brain function.

In light of this, anaesthetic technique has become a focal point in the effort to reduce POCD risk. Intravenous and inhalational agents have been compared for their neurocognitive outcomes, with some evidence suggesting that intravenous anaesthesia may be associated with a lower incidence of POCD in specific high-risk populations.[9] Sevoflurane and other inhalational agents have also been investigated, with studies yielding mixed results regarding their role in cognitive decline postoperatively.[10,14] Such findings highlight the need for individualized anaesthetic planning, particularly in the elderly.

Given the complexity of POCD and the variability in findings across studies, there remains a pressing need for prospective investigations focused on elderly patients undergoing elective non-cardiac surgery. Understanding how different factors—patient-related, procedural, and anaesthetic—interact to influence cognitive outcomes can guide clinical practice in minimizing cognitive morbidity. This study aims to prospectively evaluate cognitive function in elderly surgical patients receiving general anaesthesia, using validated neurocognitive assessment tools to monitor changes over time.

By systematically assessing cognitive performance preoperatively and at multiple postoperative intervals, this study seeks to identify the extent and duration of cognitive changes following general anaesthesia in elderly individuals. It also aims to explore potential associations between demographic, clinical, and perioperative factors and the occurrence of POCD. Ultimately, such research will contribute to the growing body of knowledge that informs safer anaesthetic practices and improved postoperative care for elderly patients at risk of cognitive complications.

MATERIALS AND METHODS

This prospective observational study was conducted over a period of 12 months at a tertiary care hospital to assess cognitive function in elderly patients undergoing surgery under general anaesthesia. A total of 90 patients aged 65 years and above, scheduled for elective non-cardiac surgery under general anaesthesia, were enrolled in the study. All patients provided written informed consent prior to participation. The study was approved by the Institutional Ethics Committee (IEC).

Inclusion Criteria

- Age ≥ 65 years
- Undergoing elective, non-emergency, non-cardiac surgery
- Planned use of general anaesthesia
- ASA (American Society of Anesthesiologists) physical status I–III

- Ability to understand and complete cognitive tests

Exclusion Criteria

- Pre-existing cognitive impairment or diagnosis of dementia
- Major psychiatric illness
- History of substance abuse
- Hearing or visual impairment that could interfere with cognitive testing
- Patients requiring postoperative ICU care
- Intraoperative complications like major blood loss or hypotension requiring vasopressors

Anaesthetic Protocol: All patients received a standardized general anaesthetic regimen. Premedication included midazolam 1–2 mg IV. Induction was done using propofol (1.5–2.5 mg/kg) and fentanyl (2 mcg/kg), followed by rocuronium (0.6 mg/kg) for muscle relaxation. Anaesthesia was maintained with sevoflurane in a 50:50 O_2 /N_2 O mixture and intermittent doses of fentanyl and rocuronium as needed. Vital parameters were continuously monitored and maintained within normal limits throughout the procedure.

Cognitive Assessment: Cognitive function in all enrolled patients was assessed using two standardized tools: the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA). These evaluations were carried out at multiple time points to track changes in cognitive status associated with general anaesthesia. The first assessment was performed preoperatively within 24 hours before surgery to establish a baseline cognitive function. Subsequent assessments were conducted on postoperative Day 1, Day 3, and Day 7 to monitor any cognitive decline or recovery over time. All evaluations were performed by trained neuropsychologists who were blinded to the patients' clinical and surgical details in order to eliminate bias and ensure the reliability of the findings.

Data Collection and Analysis: Demographic data, comorbidities, type and duration of surgery, anaesthetic details, and intraoperative events were recorded. Cognitive scores were compared across the different time points using paired t-tests or repeated measures ANOVA, as appropriate. A p-value < 0.05 was considered statistically significant. Statistical analysis was performed using SPSS software version 25.0.

RESULTS

[Table 1] Demographic and Clinical Characteristics of the Study Population

The study enrolled 90 elderly patients undergoing elective non-cardiac surgery under general anaesthesia, with a mean age of 70.2 ± 4.8 years, reflecting an elderly population suitable for assessing postoperative cognitive function. Among the participants, 57.78% (n=52) were males and 42.22% (n=38) were females. In terms of physical status as per the ASA classification, the majority were ASA II (50.00%, n=45), followed by ASA I (26.67%, n=24), and ASA III (23.33%, n=21), indicating a population with mild to moderate systemic disease but still considered fit for surgery. The mean duration of surgery was 95 ± 28 minutes, suggesting procedures of moderate length and complexity.

Regarding comorbid conditions, Hypertension was the most common, present in 66.67% (n=60) of patients, while 42.22% (n=38) had Diabetes Mellitus, highlighting the high burden of chronic illness in this population. As for the types of surgery performed, Abdominal surgeries were the most common (37.78%, n=34), followed by Orthopaedic and Urological surgeries, both accounting for 31.11% (n=28) of the cases. This distribution suggests a varied surgical burden, which could influence postoperative recovery and cognitive outcomes.

[Table 2] MMSE Scores Over Time

Cognitive function as measured by the Mini-Mental State Examination (MMSE) showed a significant decline immediately after surgery. The mean preoperative MMSE score was 27.4 ± 1.9, which is within the normal range. However, on Postoperative Day 1, there was a statistically significant decrease to 24.8 ± 2.3 ($p < 0.001$), indicating an acute decline in cognitive performance. By Day 3, scores had improved to 25.9 ± 2.1 ($p = 0.010$), and by Day 7, nearly returned to baseline at 26.8 ± 1.7 ($p = 0.076$, not statistically significant). These findings suggest that general anaesthesia may lead to early postoperative cognitive impairment that tends to improve over the first week.

[Table 3] MoCA Scores Over Time

Similar trends were observed using the Montreal Cognitive Assessment (MoCA), a more sensitive tool for detecting mild cognitive dysfunction. The mean baseline MoCA score was 25.1 ± 2.4, which dropped significantly to 21.7 ± 2.6 on Postoperative Day 1 ($p < 0.001$), again indicating significant cognitive decline. The score improved on Day 3 to 23.0 ± 2.2 ($p = 0.003$) and further on Day 7 to 24.2 ± 2.1, where the difference from baseline was no longer statistically significant ($p = 0.081$). This confirms that the decline was transient and most patients regained near-baseline cognitive function by one week.

[Table 4] Incidence of Postoperative Cognitive Dysfunction (POCD)

The incidence of Postoperative Cognitive Dysfunction (POCD), defined as MMSE < 24 or MoCA < 23, was highest on Day 1, with 34 patients (37.78%) affected. This declined to 23.33% (n=21) by Day 3, and further reduced to 10.00% (n=9) by Day 7, showing a clear trend of recovery over time. These findings reinforce the notion that POCD is common in the immediate postoperative period among the elderly but is largely reversible within the first week.

[Table 5] Factors Associated with POCD on Postoperative Day 1

Several factors were found to be significantly associated with the development of POCD on Postoperative Day 1. Patients who developed POCD had a higher mean age (71.8 ± 5.1 years) compared to those without POCD (69.1 ± 4.3 years) (p = 0.014), suggesting that older age may predispose to cognitive vulnerability. ASA Physical Status III was significantly more frequent in the POCD group (41.18% vs. 12.50%; p = 0.002), indicating that patients with more systemic illness are at higher risk. Additionally, those with POCD had longer surgeries (mean 104 ± 22 min vs. 89 ± 26 min; p = 0.008), and higher prevalence of hypertension (82.35% vs. 57.14%; p = 0.019) and diabetes (58.82% vs. 32.14%; p = 0.012). These results highlight that advanced age, higher ASA grade, prolonged surgery duration, and comorbidities like hypertension and diabetes are significant risk factors for early POCD in elderly surgical patients.

Table 1: Demographic and Clinical Characteristics of the Study Population (n = 90)

Variable	Number (n)	Percentage (%)
Mean Age (years)	–	70.2 ± 4.8
Gender		
Male	52	57.78%
Female	38	42.22%
ASA Physical Status		
I	24	26.67%
II	45	50.00%
III	21	23.33%
Mean Duration of Surgery (min)	–	95 ± 28
Comorbidities		
Hypertension	60	66.67%
Diabetes Mellitus	38	42.22%
Type of Surgery		
Abdominal	34	37.78%
Orthopaedic	28	31.11%
Urological	28	31.11%

Table 2: MMSE Scores Over Time

Time Point	Mean MMSE Score ± SD	p-value (vs. baseline)
Preoperative (Baseline)	27.4 ± 1.9	—
Postoperative Day 1	24.8 ± 2.3	< 0.001
Postoperative Day 3	25.9 ± 2.1	0.010
Postoperative Day 7	26.8 ± 1.7	0.076

Table 3: MoCA Scores Over Time

Time Point	Mean MoCA Score ± SD	p-value (vs. baseline)
Preoperative (Baseline)	25.1 ± 2.4	—
Postoperative Day 1	21.7 ± 2.6	< 0.001
Postoperative Day 3	23.0 ± 2.2	0.003
Postoperative Day 7	24.2 ± 2.1	0.081

Table 4: Incidence of Postoperative Cognitive Dysfunction (POCD)

Time Point	Patients with POCD (n)	Percentage (%)
Postoperative Day 1	34	37.78%
Postoperative Day 3	21	23.33%
Postoperative Day 7	9	10.00%

Table 5: Factors Associated with POCD on Postoperative Day 1

Variable	POCD (n = 34)	No POCD (n = 56)	p-value
Mean Age (years)	71.8 ± 5.1	69.1 ± 4.3	0.014
ASA III	14 (41.18%)	7 (12.50%)	0.002
Duration of Surgery (min)	104 ± 22	89 ± 26	0.008
Hypertension	28 (82.35%)	32 (57.14%)	0.019
Diabetes Mellitus	20 (58.82%)	18 (32.14%)	0.012

DISCUSSION

The present prospective study investigated postoperative cognitive function in elderly patients undergoing elective non-cardiac surgery under general anaesthesia. The study population [Table 1] had a mean age of 70.2 years, with a high burden of comorbidities such as hypertension (66.67%) and diabetes mellitus (42.22%). Similar demographic and comorbidity patterns have been associated with increased risk of cognitive decline in ageing populations, as reported by Stemmler et al.[15] The predominance of ASA class II and III patients in our cohort reflects a moderate systemic disease burden, which has previously been linked to heightened risk of cognitive dysfunction following anaesthesia and surgery.[16]

Cognitive performance, as assessed by the MMSE, declined significantly on postoperative Day 1 (mean 24.8 vs. 27.4 at baseline, p < 0.001), gradually improving by Day 7 (26.8, p = 0.076) [Table 2]. These results are consistent with findings from broader POCD research, which notes that cognitive impairment is often most prominent within the first few postoperative days and typically improves over time.[17] The use of MoCA in our study revealed a similar pattern [Table 3], with Day 1 scores decreasing to 21.7 ($p < 0.001$) and returning close to baseline by Day 7 (24.2, $p = 0.081$). Kalbe et al,[7] emphasized the value of using sensitive tools such as DemTect or MoCA in identifying early or subtle postoperative cognitive changes, supported also by Bolló-Gasol et al,[8] in the context of detecting cognitive impairments in elderly populations.

The incidence of POCD was 37.78% on Day 1 and decreased to 10.00% by Day 7 [Table 4], which aligns with previous literature indicating that transient POCD occurs in approximately 30–40% of elderly patients undergoing major surgery. Steinmetz et al. and Patel et al. have both highlighted this transient nature, with resolution in many cases but persistence in a notable minority.[17] The OPTIMA study further demonstrated that although early cognitive impairment may recover, it still carries the potential for long-term decline, particularly in elderly patients exposed to general anaesthesia.[17]

Risk factors for POCD identified in our study included older age, ASA III status, longer surgery duration, hypertension, and diabetes [Table 5]. These associations are supported by previous studies that found age, comorbidities, and surgical burden to be significant contributors to cognitive dysfunction. Li et al,[18] in a recent large-scale Chinese cohort study, confirmed the prospective association between general anaesthesia and increased risk of cognitive decline in elderly individuals.

Anaesthetic technique also plays a crucial role. Wagner et al,[9] found that patients with a high risk for obstructive sleep apnea (OSA) experienced less POCD when managed with intravenous anaesthesia. However, in a follow-up study, Wagner et al,[10] observed that short-term cognitive function was more impaired following sevoflurane anaesthesia in suspected OSA patients. This underscores the importance of tailoring anaesthetic plans to individual patient risks and physiology.

Xenon-based anaesthesia, though not used in our study, offers a promising avenue for future research. Hofland et al,[11] demonstrated in a multicentre trial that xenon anaesthesia led to lower cardiac and possibly neurological stress compared to sevoflurane and total intravenous anaesthesia in cardiac surgery patients. Rylova and Maze,[12] expanded on xenon's neuroprotective mechanisms, particularly through NMDA receptor antagonism, supporting its potential use in neurosurgical and elderly populations.

Pre-existing cognitive deficits can influence postoperative outcomes significantly. Cheng et al,[13] showed that carotid artery stenting in patients with mild cognitive impairment not only improved cerebral blood flow but also enhanced cognitive function, highlighting the importance of vascular factors. Dittrich and Johansen,[14] found that cognitive deficits in executive functioning were predictive of poorer cognitive resilience, even in psychiatric settings. These findings stress the need for preoperative cognitive screening, especially in elderly patients undergoing major surgery.

Using sensitive tools like MoCA or DemTect can help identify at-risk individuals preoperatively.[7] This approach is echoed by Wagner et al,[19] who found that the response to anaesthetic stress and cognitive trajectory postoperatively varies based on both the anaesthetic regimen and individual patient profiles.

While POCD in our study was largely reversible, even temporary impairment has meaningful implications. Evered et al. and other researchers have shown that early cognitive decline following surgery may predispose individuals to long-term cognitive disorders, including dementia, especially after cardiac procedures.[17]

CONCLUSION

This study demonstrates that elderly patients undergoing elective non-cardiac surgery under general anaesthesia are at significant risk of developing early postoperative cognitive dysfunction (POCD), with the highest incidence observed on postoperative Day 1. Cognitive decline was largely transient, with most patients showing near-baseline recovery by Day 7. Factors such as advanced age, higher ASA grade, longer surgery duration, and comorbidities like hypertension and diabetes were significantly associated with POCD. These findings highlight the importance of preoperative cognitive screening and individualized perioperative care to minimize cognitive complications in the elderly surgical population.

REFERENCES

1. Monk TG, Weldon BC, Garvan CW, et al. Predictors of cognitive dysfunction after major noncardiac surgery. Anesthesiology. 2008;108:18–30.
2. Monk TG, Saini V, Weldon BC, et al. Anesthetic management and one-year mortality after noncardiac surgery. Anesth Analg. 2005;100:4–10.
3. Steinmetz J, Christensen KB, Lund T, et al. Long-term consequences of postoperative cognitive dysfunction. Anesthesiology. 2009;110:548–55.
4. Newman MF, Kirchner JL, Phillips-Bute B, et al. Longitudinal assessment of neurocognitive function after coronary-artery bypass surgery. N Engl J Med. 2001;344:395–402. Erratum in: N Engl J Med. 2001;344(24):1876.
5. Evered LA, Silbert BS, Scott DA, et al. Prevalence of dementia 7.5 years after coronary artery bypass graft surgery. Anesthesiology. 2016;125:62–71.
6. Grocott HP, Mackensen GB, Grigore AM, et al. Postoperative hyperthermia is associated with cognitive dysfunction after coronary artery bypass graft surgery. Stroke. 2002;33:537–41.
7. Kalbe E, Kessler J, Calabrese P, Smith R, Passmore AP, Brand M, et al. DemTect: a new, sensitive cognitive screening test to support the diagnosis of mild cognitive impairment and early dementia. Int J Geriatr Psychiatry. 2004;19:136–43.
8. Bolló-Gasol S, Piñol-Ripoll G, Cejudo-Bolivar JC, Llorente-Vizcaino A, Peraita-Adrados H. Evaluación ecológica en el deterioro cognitivo leve y enfermedad de Alzheimer mediante el Rivermead behavioural memory test. Neurología. 2014;29:339–45.

9. Wagner S, Quente J, Staedtler S, Koch K, Richter-Schmidinger T, Kornhuber J, et al. A high risk of sleep apnea is associated with less postoperative cognitive dysfunction after intravenous anesthesia: results of an observational pilot study. BMC Anesthesiol. 2018;18:139.
10. Wagner S, Sutter L, Wagenblast F, Walther A, Schiff JH. Short term cognitive function after sevoflurane anesthesia in patients suspect to obstructive sleep apnea syndrome: an observational study. BMC Anesthesiol. 2021;21:150.
11. Hofland J, Ouattara A, Fellahi JL, et al. Effect of xenon anesthesia compared to sevoflurane and total intravenous anesthesia for coronary artery bypass graft surgery on postoperative cardiac troponin release: an international, multicenter, phase 3, single-blinded, randomized noninferiority trial. Anesthesiology. 2017;127:918–33.
12. Rylova A, Maze M. Protecting the brain with xenon anesthesia for neurosurgical procedures. J Neurosurg Anesthesiol. 2019;31:18–29.
13. Cheng Y, Wang YJ, Yan JC, Zhou R, Zhou HD. Effects of carotid artery stenting on cognitive function in patients with mild cognitive impairment and carotid stenosis. Exp Ther Med. 2013;5:1019–24.
14. Dittrich WH, Johansen T. Cognitive deficits of executive functions and decision-making in obsessive-compulsive disorder. Scand J Psychol. 2013;54:393–400.
15. Stemmler M, Petermann F, Daseking M, Siebert J, Schott H, Lehfeld H, et al. Diagnostik und Verlauf von kognitiven Fähigkeiten bei älteren Menschen. Gesundheitswesen. 2013;75:761–7.
16. Cottrell JE, Hartung J. Anesthesia and cognitive outcome in elderly patients: a narrative viewpoint. J Neurosurg Anesthesiol. 2020;32(1):9–17.
17. Patel D, Lunn AD, Smith AD, Lehmann DJ, Dorrington KL. Cognitive decline in the elderly after surgery and anaesthesia: results from the Oxford Project to Investigate Memory and Ageing (OPTIMA) cohort. Anaesthesia. 2016;71(10):1144–52.
18. Li W, Jiang J, Zhang S, et al. Prospective association of general anesthesia with risk of cognitive decline in a Chinese elderly community population. Sci Rep. 2023;13:13458.
19. Wagner S, Breitkopf M, Ahrens E, et al. Cognitive function in older patients and their stress challenge using different anesthesia regimes: a single center observational study. BMC Anesthesiol. 2023;23:6.