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Original Research Article

A Comparison Study on the Effects of General Anesthesia on Postoperative Cognitive Dysfunction Among Young Adults and Elderly Patients

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Conflict of interest: Nil

Abstract

Background: Postoperative cognitive dysfunction (POCD) is a frequent neurocognitive complication following general anesthesia (GA), particularly in elderly patients. Evidence comparing early cognitive changes between young adults and elderly individuals remains limited.

Aim: To evaluate and compare the effects of general anesthesia on postoperative cognitive function among young adults and elderly patients.

Methods: This observational study included 60 patients undergoing elective surgery under GA at a tertiary care hospital. Participants were divided into young adults (18–40 years) and elderly patients (>65 years). Cognitive function was assessed using the Standardized Mini-Mental State Examination (SMMSE) immediately after surgery (0th hour) and at 45 minutes postoperatively. Descriptive statistics and chi-square tests were used for analysis.

Results: POCD was observed in 90% of patients at the 0th hour, decreasing to 51.7% at 45 minutes postoperatively. Severe cognitive impairment was predominant immediately after surgery (51.7%) but reduced markedly at 45 minutes (3.3%). Elderly patients demonstrated significantly higher rates of POCD and slower cognitive recovery compared with young adults ($p < 0.001$). Gender showed a significant association with cognitive scores, whereas ASA grading did not.

Conclusion: General anesthesia is associated with a high incidence of early POCD, particularly in elderly patients. Although partial recovery occurs within the early postoperative period, older individuals remain more vulnerable. Early cognitive assessment and age-specific perioperative strategies are essential to mitigate POCD.

Keywords: General Anesthesia; Postoperative Cognitive Dysfunction; MMSE; Elderly; Young Adults.

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Introduction

General anesthesia induces a reversible state of unconsciousness characterized by amnesia, analgesia, and immobility, enabling the safe performance of complex surgical procedures. Despite its clinical indispensability, increasing attention has been directed toward its potential impact on postoperative cognitive function, particularly among elderly patients. Postoperative cognitive dysfunction (POCD) refers to a decline in cognitive domains such as memory, attention, and executive function following anesthesia and surgery. Unlike delirium, POCD is subtle, does not fluctuate, and often requires neuropsychological testing for detection. Advancing age is a well-established risk factor for POCD, likely due to reduced cognitive reserve, pre-existing neurodegenerative changes, and heightened neuroinflammatory responses. While elderly patients account for a disproportionate share of surgical procedures, data on anesthesia-related cognitive effects in young adults remain sparse, as cognitive changes in this group are typically transient and less severe. Understanding

age-related differences in early postoperative cognitive outcomes is therefore clinically relevant.

Materials and Methods

Study Design and Setting: An observational study was conducted in the Department of Anesthesiology at a tertiary care teaching hospital.

Sample Size and Participants: A total of 60 patients undergoing elective surgery under general anesthesia were enrolled. Participants were categorized into:

- **Young adults:** 18–40 years
- **Elderly:** >65 years

Inclusion Criteria

- ASA physical status I–III
- Elective surgery under GA lasting 1–4 hours
- No prior history of cognitive, neurological, or psychiatric disorders

Exclusion Criteria

- Use of sedatives, opioids, or antidepressants
- Pre-existing neurological disease
- Perioperative complications (e.g., stroke, severe hypotension)
- Refusal to provide informed consent

Data Collection: Demographic and clinical data were recorded. Cognitive function was assessed using the Standardized Mini-Mental State Examination (SMMSE) at the 0th postoperative hour and again at 45 minutes.

Statistical Analysis: Data were analyzed using descriptive statistics. Associations between variables were assessed using the chi-square test, with $p < 0.05$ considered statistically significant.

Results

Of the 60 participants, 51.7% were elderly and 48.3% were young adults; 58.3% were female. At the immediate postoperative assessment, 90% of patients demonstrated POCD, with severe cognitive impairment observed in 51.7%. At 45 minutes postoperatively, POCD prevalence decreased to 51.7%, and 50% of patients regained normal cognitive status. A total of 60 patients undergoing elective surgery under general anesthesia were analyzed. Cognitive performance was assessed using the Standardized Mini-Mental State Examination (SMMSE) immediately after surgery (0th hour) and at 45 minutes postoperatively.

Table 1: Demographic Characteristics and ASA Physical Status (n = 60)

Variable	Category	n (%)
Age group	Young adults (18–40 years)	29 (48.3)
	Elderly (>65 years)	31 (51.7)
Gender	Male	25 (41.7)
	Female	35 (58.3)
ASA grade	Grade I	14 (23.3)
	Grade II	26 (43.3)
	Grade III	20 (33.3)

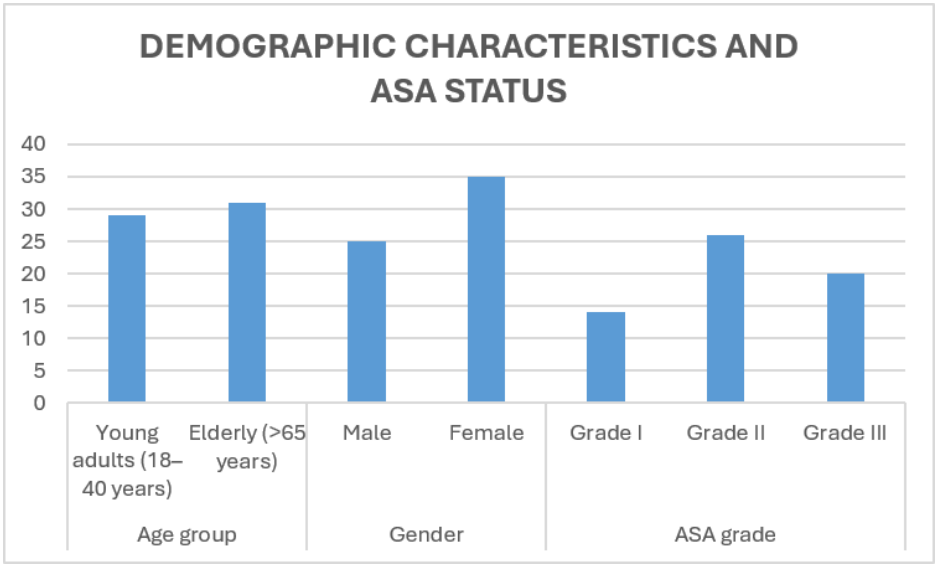

Figure 1: Demographic Characteristics and ASA Physical Status

Interpretation: The study population showed nearly equal distribution between young adults and elderly patients. Most participants belonged to ASA Grades II and III, indicating mild to moderate systemic disease.

Table 2: Cognitive Status and POCD at 0th Hour and 45 Minutes Postoperatively

Time point	Cognitive status	n (%)	POCD present n (%)	POCD absent n (%)
0th hour	Normal	7 (11.7)		
	Mild impairment	16 (26.7)		
	Moderate impairment	6 (10.0)		
	Severe impairment	31 (51.7)	54 (90.0)	6 (10.0)
45 minutes	Normal	30 (50.0)		
	Mild impairment	15 (25.0)		
	Moderate impairment	13 (21.7)		
	Severe impairment	2 (3.3)	31 (51.7)	29 (48.3)

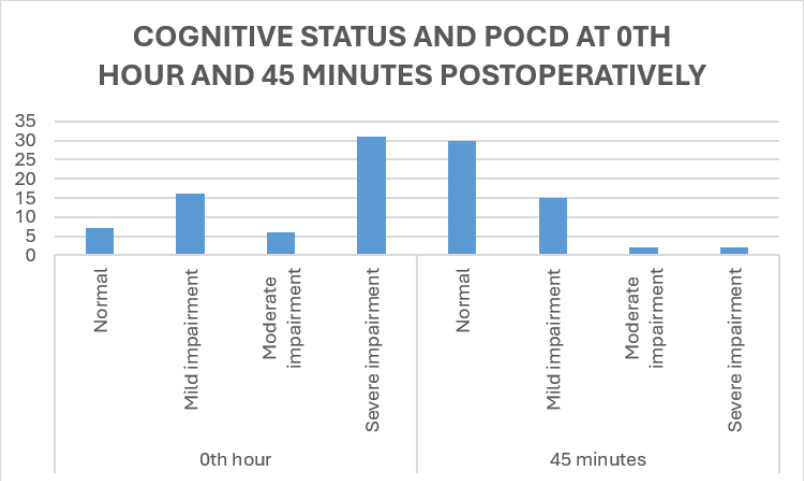

Figure 2: Cognitive Status and POCD at 0th Hour and 45 Minutes Postoperatively

Interpretation: POCD was highly prevalent immediately after surgery, with severe cognitive impairment predominating. At 45 minutes, cognitive recovery was evident; however, more than half of the patients continued to show POCD.

Table 3: Association of Clinical Variables with Postoperative Cognitive Dysfunction

Variable	Outcome	χ^2 value	p-value	Significance
Age group	MMSE at 0th hour	26.800	<0.001	Significant
Age group	MMSE at 45 minutes	26.533	<0.001	Significant
Gender	MMSE scores	26.800	<0.001	Significant
ASA grade	MMSE scores	0.067	0.796	Not significant

Interpretation: Age was significantly associated with postoperative cognitive dysfunction at both assessment points. Gender showed a significant association with cognitive scores, while ASA physical status did not influence POCD.

A statistically significant association was observed between age and cognitive impairment at both time points ($p < 0.001$). Elderly patients exhibited higher severity of POCD and slower recovery. Gender showed a significant association with MMSE scores, whereas ASA grading was not significantly related to cognitive outcomes.

Discussion

Postoperative cognitive dysfunction (POCD) is a well-recognized neurocognitive complication following general anesthesia, particularly in elderly patients. The present study evaluated early postoperative cognitive changes using the Standardized Mini-Mental State Examination (SMMSE) and demonstrated a high incidence of POCD immediately after surgery, with partial recovery within 45 minutes. These findings are consistent with and extend earlier evidence highlighting age-related vulnerability to anesthesia-associated cognitive impairment. In the immediate postoperative period, POCD was observed in 90% of patients, with severe cognitive impairment present in more than half of the cohort. Similar early postoperative cognitive decline has been reported in previous investigations. Monk et al. documented significant cognitive dysfunction within the first postoperative day following non-cardiac surgery, attributing early impairment to the combined effects of anesthetic exposure, surgical stress, and inflammatory responses. Rundshagen also emphasized that early POCD is common after general anesthesia and may be underestimated due to its subtle and transient nature. The high prevalence observed in the present study reinforces

the importance of early cognitive screening in the post-anesthesia care unit.

At 45 minutes postoperatively, the prevalence of POCD decreased to 51.7%, and 50% of patients regained normal cognitive status, indicating partial early recovery. This finding aligns with observations by Canet et al., who reported that a proportion of elderly patients demonstrate rapid cognitive improvement in the immediate postoperative period, although deficits may persist in others. Similarly, Silbert et al. observed that younger patients tend to recover cognitive function more rapidly, whereas elderly patients show delayed or incomplete recovery. The present results support the notion that early POCD is often transient but not universally reversible within the immediate postoperative window.

Age was found to be a strong and statistically significant predictor of postoperative cognitive dysfunction at both assessment time points. Elderly patients exhibited greater severity of POCD and slower cognitive recovery compared with young adults. This finding is consistent with the landmark ISPOCD-1 study by Møller et al., which reported POCD in 25.8% of elderly patients at one week and 9.9% at three months postoperatively, establishing age as the most important risk factor. Deiner and Silverstein further emphasized that aging is associated with reduced cognitive reserve, impaired neuroplasticity, and exaggerated neuroinflammatory responses, all of which increase susceptibility to POCD. The present study corroborates these observations by demonstrating significant age-related differences even in the early postoperative period.

Gender showed a statistically significant association with postoperative cognitive scores in this study. While earlier literature on sex-based differences in POCD is limited and inconsistent, some studies have suggested that hormonal and immunological differences may influence neuroinflammatory responses and anesthetic pharmacodynamics. However, large trials such as those by Steinmetz et al. did not consistently identify gender as an independent predictor of POCD. Therefore, the gender association observed in the present study should be interpreted cautiously and may reflect sample characteristics rather than a definitive biological effect.

In contrast, ASA physical status did not show a significant association with postoperative cognitive dysfunction. This finding is in agreement with reports by Kotekar et al., who noted that while higher ASA status reflects systemic disease burden, age and duration of anesthesia were stronger predictors of POCD. The lack of association in the present study suggests that early postoperative cognitive impairment may be driven more by neurobiological vulnerability related to aging rather than by the presence of systemic comorbidities alone.

The findings of this study are consistent with earlier literature demonstrating that POCD is common after general anesthesia, particularly among elderly patients, and that recovery patterns differ substantially by age. The study adds to existing evidence by highlighting that significant age-related differences are detectable even within the first hour after surgery. These results underscore the need for routine early cognitive assessment and targeted perioperative strategies, especially in elderly patients, to minimize the burden of POCD and improve postoperative outcomes.

Conclusion

This study demonstrates that postoperative cognitive dysfunction is a common early complication following general anesthesia, with a markedly higher incidence and greater severity among elderly patients compared with young adults. Cognitive impairment was highly prevalent in the immediate postoperative period, with severe dysfunction predominating; although partial cognitive recovery was observed within 45 minutes, more than half of the patients continued to exhibit features of POCD.

Age emerged as the most significant determinant of postoperative cognitive outcomes, with elderly patients showing slower and less complete recovery, reflecting reduced cognitive reserve and increased vulnerability of the aging brain to anesthesia- and surgery-related insults. Gender showed a significant association with early postoperative cognitive performance, whereas ASA physical status did not significantly influence cognitive outcomes, suggesting that chronological age may be a stronger predictor of early POCD than systemic disease burden.

The findings underscore the importance of early postoperative cognitive assessment, particularly in elderly patients undergoing general anesthesia. Implementation of age-specific perioperative strategies, including careful anesthetic titration, optimization of intraoperative physiological parameters, and early cognitive monitoring, may help reduce the incidence and impact of POCD. Further studies with larger sample sizes and longer follow-up are warranted to clarify long-term cognitive outcomes and to develop effective preventive and therapeutic interventions.

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