

Effects of Post-Operative Cognitive Dysfunction (Pocd) After General Anesthesia In Geriatric Patients

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ABSTRACT

Objective: To compare the effects of post-operative cognitive dysfunction (POCD) after general anesthesia in geriatric patients

Study Design: Prospective observational study

Place and Duration of Study: Anesthesia Department of Combined Military Hospital, Peshawar, Pakistan, from Jun to Dec 2022.

Methodology: A sample of 330 patients between the ages of 55 and 85 years was included in the study, undergoing elective surgery under general anesthesia. Primary variables measured were MMSE pre-operatively and 12 and 24 hours after surgery, and the effects of POCD were assessed.

Results: Mean age of patients was 69.52 ± 6.69 years, and mean weight was 68.44 ± 3.81 kg. Mean duration of surgeries done was 129.26 ± 6.6 minutes. Gender distribution revealed a total of 148 (44.8%) males and 182 (55.2%) females in the group. When cognitive variables were checked in the patients, it was seen that there was marked deterioration in orientation, registration, attention, recall, language, and copying at the 12- and 24-hour intervals on the MMSE. The median MMSE score at the 12-hour interval was 26 (IQR=2.00) versus 27 (IQR=1.00) at the 24-hour interval ($p < 0.001$). The score improved at the 24-hour interval but was still lower than the score assessed pre-operatively.

Conclusion: It was concluded that general anesthesia is associated with POCD, predominantly affecting the logical memory in the geriatric population.

Keywords: General anesthesia, geriatric, post-operative cognitive dysfunction (POCD)

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INTRODUCTION

General anesthesia remains the major modality for surgical procedures in all age groups for a large number of surgeries.¹ From intravenous drugs to inhalational agents, general anesthesia modalities produce sedation, analgesia, and paralysis for adequate patient preparation for surgery.² However, the drugs and agents used have major pharmacokinetic and pharmacodynamic effects on the body, resulting in post-operative effects affecting patient outcome and subsequent successful recovery.³

Post-operative cognitive dysfunction (POCD) is a new cognitive impairment arising after surgical anesthesia, resulting in memory and psychomotor impairment.⁴ The term was established in the early 1950s as “adverse cerebral effects of anesthesia on old people” by Bedford et al.⁵ and has since been used to define neurological impairment seen after operative

procedures, mainly after general anesthesia, especially in the elderly.^{6,7}

General anesthesia has been associated with post-operative cognitive dysfunction.⁸ Various studies have demonstrated no significant impairment in the middle-aged and young age groups except in cases of multiple exposures to general anesthesia.⁹ However, the geriatric group remains an important group of concern. The mechanisms for cognitive impairment are thought to be pro-inflammatory factors and immune responses to general anesthesia and the effects of the drugs themselves, resulting in reversible neurological depression that may take weeks or maybe months to recover.¹⁰

Since general anesthesia is given in most geriatric patients undergoing elective surgeries, its effects with respect to our demographic population need to be studied for better patient outcomes, resulting in fewer hospital days and decreased resource burden. This study aims to compare the effects of post-operative cognitive dysfunction (POCD) after general anesthesia

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in the geriatric age group between 55 and 85 years of age.

METHODOLOGY

This prospective observational study was carried out at the Department of Anesthesiology, Combined Military Hospital, Peshawar, Pakistan, from Jun to Dec 2022 after approval from the ethical review board vide letter no. 0348/22/psc, dated 30-06-2022. 330 (estimated; WHO calculator sample size calculated: 321) patients between the ages of 55 and 85 years of age were included in the study after calculating the sample size using the WHO calculator, keeping the confidence interval at 95% and the margin of error at 5%, with the population prevalence of POCD after general anesthesia being 29.7%¹¹ in recent literature and studies.

Inclusion Criteria: included all ASA I and II, male and female patients presenting to the hospital for elective surgeries under general anesthesia between 55 and 85 years of age, patients with an educational level of matriculation or higher with the ability to understand and follow the MMSE questionnaire, and patients giving consent to be included in the study.

Exclusion Criteria: included patients with major cardiac or respiratory disease, low ejection fraction, allergy to propofol, atracurium, coagulation disorders, pregnancy, ongoing hypothermia or hypoxia/hypoxemia, blood pressure or heart rate exceeding 20% of baseline according to age, patients with known cognitive defects, dementia, Alzheimer's, and patients who did not give consent to be included in the study.

The study included all patients meeting the inclusion criteria. The sampling method was nonprobability consecutive sampling using a lottery method to select patients for inclusion in the study. Once patients were included in the study, informed written consent was obtained. A standard Mini-Mental State Examination (MMSE)¹² questionnaire was administered preoperatively by a resident anesthetist unaware of the study protocol and the reason for assessment, and the total score was recorded.

Standard monitoring, including non-invasive blood pressure, heart rate, capnography, and ECG, was attached to participants in both groups. General anesthesia was induced in both groups with IV Propofol 1.5 mg/kg, IV Nalbuphine 0.15 mg/kg, and IV Atracurium 0.5 mg/kg, and maintained with

Isoflurane at 1.0 MAC. At the end of surgery, reversal was done with neostigmine with Glycopyrrolate at 0.04 mg/kg. In both groups, bradycardia was defined as a heart rate of <60 beats per minute and hypotension as MAP <50 mm Hg, and was treated with 5 mg ephedrine and 600 mcg of glycopyrrolate where needed.

Post-operatively, the patients were retained in the post-operative surgical ward, and the MMSE score was assessed after 12 and 24 hours, respectively, by an anesthesia resident unaware of the study protocol. Primary variables measured were MMSE pre-operatively and 12 and 24 hours after surgery. Incidence of hypotension and bradycardia was noted. Demographic data were statistically described in terms of mean and SD, frequencies, and percentages when appropriate. Wilcoxon signed-rank test was used to compare statistical significance between the MMSE scale at 12 and 24-hour post general anesthesia. A *p*-value of ≤0.05 was considered statistically significant. All statistical calculations were performed using Statistical Package for the Social Sciences 26.0.

RESULTS

A total of 330 patients were included in the study, observed and evaluated for POCD at the 12- and 24-hour intervals using the MMSE. The mean age of patients was 69.52±6.69 years, and the mean weight was 68.44±3.81 kg. Mean duration of surgeries done was 129.26±6.6 minutes (Table-I). Gender distribution revealed a total of 148 (44.8%) males and 182 (55.2%) females in the group, while 185(56.1%) patients were classified as ASA-I and 145 (43.9%) as ASA-II.

Table-I: Demographic characteristics (n=330)

Variable	Values
Mean Age (Years)	69.52±6.69
Mean Weight (Kg)	68.44±3.81
Mean Duration Of Surgery (Min)	129.26±6.69

*POCD - Post-Operative Cognitive Dysfunction

When comparing the mini-mental state exam factors, the total pre-operative MMSE score was unchanged with a total score of 30. However, the post-operative MMSE score at 12 hours and 24 hours was significantly different. When individual variables were checked in the patients, it was seen that there was marked deterioration in orientation, attention, recall, language, and copying at the 12-hour interval on the MMSE. A near-comparable trend was seen in parameters of the MMSE at the 24-hour duration. Statistically speaking, the difference between

orientation, attention, registration, recall, language, and copying was significant (Table-II). When total scores were compared at the 12-hour and 24-hour intervals, they were found to be highly significant ($p<0.001$) (Table-II).

Table-II: Comparison of MMSE parameters (n=330)

Baseline Characteristics	Study Groups		p-Value
	12-hour post-surgery (n=55)	24-hour post-surgery (n=55)	
Orientation (Out of 10)	9.00 (2.00)	10 (0.00)	0.001
Registration (Out of 3)	2.00 (1.00)	3.00 (0.00)	0.001
Attention and calculation (Out of 5)	3.00 (1.00)	3.00 (1.00)	0.001
Recall (Out of 3)	1.00 (1.00)	3.00 (0.00)	0.001
Language (Out of 8)	4.00 (1.00)	7.00 (0.00)	0.001
Copying (Out of 1)	0.00 (1.00)	1.00 (0.00)	0.001
Total Score (Out of 30)	26.00 (2.00)	27.00 (1.00)	0.001

The median of MMSE at 12-hour interval was 26(IQR=2.00) versus 27(IQR=1.00) at the 24-hour interval ($p<0.001$). The score improved at the 24-hour interval but was still lower than the score assessed pre-operatively.

DISCUSSION

The main aim of the study was to assess the extent to which POCD affects the population at the upper extreme of age and to determine whether patients kept under postoperative observation had adequate cognitive function to return. The study reports that scores at 12 and 24 hours were significantly different. At the 12-hour interval, marked deterioration in orientation, attention, recall, language, and copying was observed. Although these parameters improved at the 24-hour interval, scores remained significantly lower than those calculated preoperatively.

It is now widely accepted that POCS affects all age groups after general anesthesia, with the extremes of age affected more.¹³ The time and duration of surgery were initially thought to be a contributory factor; however, it is now being proposed that surgeries less than 3 hours have similar effects on all age groups.¹⁴ Kristek *et al.*, reported that regarding surgical time and POCD incidence should be further evaluated. When talking about the type of surgery, cardiac surgery carries an increased risk and incidence of POCD with prolonged recovery time compared with non-cardiac surgery.¹⁵

When talking about POCD and its assessment, it is seen that logical memory is affected more and tends to recover more slowly than orientation and copying,

as reported by Bhushan *et al.*¹⁶ The time to perform calculations is affected, as well as the time to analyze objects. This was seen in our study as well, with the parameters of logical memory (analyzing, calculating) affected more, with a lower mean score than other parameters. This was also seen in a study carried out by Mahanna *et al.*¹⁷ This shows that higher centers of learning are affected more and tend to recover more slowly than other parameters. Shenning *et al.*, discussed the underlying chemical and molecular mechanisms activated because of the stress of surgery and general anesthesia, which range from immune activation to changes in brain modulators, including cytokines, and all result in delayed response and neurological recovery in these patients.¹⁸ Cognitive impairment is common in older surgical patients and is associated with postoperative delirium. However, cognitive function is inconsistently assessed preoperatively, leading to missed opportunities to recognize vulnerable patients. Molecular markers are needed at the molecular level to establish a cause-and-effect relationship in our demographic area to further understand the dynamics.¹⁹

It is recommended that POCD be checked and evaluated, especially in the geriatric age group undergoing general anesthesia, and that strategies be employed for early detection, good counselling, and follow-up to diagnose any residual neurological defect in the long term, resulting in better patient care.

LIMITATION OF STUDY

The limitations of this study are that of a single center. A multi-center study will cater more to our demographic area. This study is also constrained to a 24-hour evaluation due to poor follow-up. Long-term cognitive deficits, if any, require follow-up and assessment to rule out chronic POCD.

CONCLUSION

It was concluded that general anesthesia is associated with early post-operative cognitive dysfunction in the geriatric population, with measurable impairment across several cognitive domains, particularly logical memory, recall, attention, language, orientation, and visuospatial copying. Although the median MMSE score improved significantly from 26 at 12 hours to 27 at 24 hours after surgery, cognitive performance remained below the pre-operative score, indicating that recovery was incomplete during the first postoperative day. These findings emphasize the importance of pre-operative cognitive assessment, close postoperative monitoring, early recognition of cognitive decline, appropriate counselling of patients and caregivers, and timely follow-up in older adults undergoing general anesthesia. Further multicenter studies with longer follow-

up are required to determine the persistence, clinical consequences, and predictors of POCD beyond the immediate postoperative period.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

NI & AHB: Data acquisition, data analysis, critical review, approval of the final version to be published.

MW & SH: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

ST & RFA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Brown EN, Pavone KJ, Naranjo M. Multimodal general anesthesia: theory and practice. *Anesth Analg* 2018; 127(5): 1246-1258. <https://doi.org/10.1213/ANE.0000000000003668>
2. Pavel MA, Petersen EN, Wang H, Lerner RA, Hansen SB. Studies on the mechanism of general anesthesia. *Proc Natl Acad Sci USA* 2020; 117(24): 13757-13766. <https://doi.org/10.1073/pnas.2004259117>
3. Nilsson U, Jaensson M, Dahlberg K, Hugelius K. Postoperative recovery after general and regional anesthesia in patients undergoing day surgery: a mixed methods study. *J PeriAnesth Nurs* 2019; 34(3): 517-528. <https://doi.org/10.1016/j.jopan.2018.07.003>
4. Czyż-Szyphenbejl K, Mędrzycka-Dąbrowska W, Kwiecień-Jaguś K, Lewandowska K. The occurrence of postoperative cognitive dysfunction (POCD): systematic review. *Psychiatr Pol* 2019; 53(1): 145-160. <https://doi.org/10.12740/PP/81628>
5. Severin G. Diagnostic criteria for post-operative cognitive dysfunction: literature review. *J Anesth Clin Res* 2018; 9(8): 1000850.
6. Daiello LA, Racine AM, Yun Gou R, Marcantonio ER, Xie Z, Kunze LJ, et al. Postoperative delirium and postoperative cognitive dysfunction: overlap and divergence. *Anesthesiology* 2019; 131(3): 477-491. <https://doi.org/10.1097/ALN.0000000000002788>
7. Berger M, Nadler JW, Browndyke J, Terrando N, Ponnusamy V, Cohen HJ, et al. Postoperative cognitive dysfunction: minding the gaps in our knowledge of a common postoperative complication in the elderly. *Anesthesiol Clin* 2015; 33(3): 517-550. <https://doi.org/10.1016/j.ancin.2015.05.008>
8. Tzimas P, Samara E, Petrou A, Korompilias A, Chalkias A, Papadopoulos G. The influence of anesthetic techniques on postoperative cognitive function in elderly patients undergoing hip fracture surgery: General vs spinal anesthesia. *Injury* 2018; 49(12): 2221-2226. <https://doi.org/10.1016/j.injury.2018.09.023>
9. Kotekar N, Shenkar A, Nagaraj R. Postoperative cognitive dysfunction-current preventive strategies. *Clin Interv Aging* 2018; 13: 2267-2273. <https://doi.org/10.2147/CIA.S133896>
10. Lin X, Chen Y, Zhang P, Chen G, Zhou Y, Yu X. The potential mechanism of postoperative cognitive dysfunction in older people. *Exp Gerontol* 2020; 130: 110791. <https://doi.org/10.1016/j.exger.2019.110791>
11. Ehsani R, Motlagh SD, Zaman B, Kashani SS, Ghodratty MR. Effect of general versus spinal anesthesia on postoperative delirium and early cognitive dysfunction in elderly patients. *Anesth Pain Med* 2020; 10(4): e101820. <https://doi.org/10.5812/aapm.101820>
12. Healthdirect. Mini-Mental State Examination (MMSE) [Internet]. Healthdirect; 2025 [cited 2026 Sep 2]. Available from: <https://www.healthdirect.gov.au/mini-mental-state-examination-mmse>
13. Yu Q, Qi J, Wang Y. Intraoperative hypotension and neurological outcomes. *Curr Opin Anesthesiol* 2020; 33(5): 646-650. <https://doi.org/10.1097/ACO.0000000000000908>
14. Evered LA, Silbert BS. Postoperative cognitive dysfunction and noncardiac surgery. *Anesth Analg* 2018; 127(2): 496-505. <https://doi.org/10.1213/ANE.0000000000003514>
15. Kristek G, Radoš I, Kristek D, Kapural L, Nešković N, Škiljić S, et al. Influence of postoperative analgesia on systemic inflammatory response and postoperative cognitive dysfunction after femoral fracture surgery: a randomized controlled trial. *Reg Anesth Pain Med* 2019; 44(1): 59-68. <https://doi.org/10.1136/rapm-2018-000017>
16. Bhushan S, Li Y, Huang X, Cheng H, Gao K, Xiao Z. Progress of research in postoperative cognitive dysfunction in cardiac surgery patients: A review article. *Int J Surg* 2021; 95: 106163. <https://doi.org/10.1016/j.ijsu.2021.106163>
17. Mahanna-Gabrielli E, Zhang K, Sieber FE, Lin HM, Liu X, Sewell M, et al. Frailty is associated with postoperative delirium but not postoperative cognitive decline in older non-cardiac surgery patients. *Anesth Analg* 2020; 130(6): 1516-1523. <https://doi.org/10.1213/ANE.0000000000004771>
18. Schenning KJ, Murchison CF, Mattek NC, Kaye JA, Quinn JF. Sex and genetic differences in postoperative cognitive dysfunction: a longitudinal cohort analysis. *Biol Sex Differ* 2019; 10(1): 1-9. <https://doi.org/10.1186/s13293-019-0256-8>
19. Susano MJ, Grasfield RH, Friese M, Rosner B, Crosby G, Bader AM, et al. Brief preoperative screening for frailty and cognitive impairment predicts delirium after spine surgery. *Anesthesiology* 2020; 133(6): 1184-1191. <https://doi.org/10.1097/ALN.0000000000003523>