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ORIGINAL RESEARCH GERIATRIC ANESTHESIA

The effects of total intravenous vs inhalational anesthesia on postoperative cognitive dysfunction in elderly patients

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ABSTRACT

Background: The fast expanding demographic segment of the elderly population has resulted in an increase in the people aged 65 y and above, needing surgical treatments. This change has posed special medical problems including need of surgical management, while preventing postoperative complications. We compared the postoperative cognitive injury in older adults between total intravenous anesthesia (TIVA) and inhalational anesthesia. It lays the groundwork for anesthesiology and perioperative care research and clinical choices in elderly.

Methodology: With exclusions for cognitive disabilities and neurologic disorders, participants of ≥ 65 y of age, scheduled for elective surgery, were randomly assigned to TIVA or inhalational anesthesia groups. Preoperative exams were carried out, including Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) cognitive tests. While the inhalation group got inhalational sevoflurane or desflurane with opioids, TIVA group received propofol and remifentanil IV. The incidence of Postoperative Cognitive Dysfunction (POCD) was the main outcome; while secondary outcomes included hospital stay, any complications, anesthesia and surgery durations and three-month mortality.

Results: On days 1 and 3 postoperative cognitive scores (POCS) dropped dramatically; on day 7 in both TIVA and inhalational anesthesia groups, they rose again. On day 1, TIVA group patients demonstrated better cognitive scores than the inhalational group. On days 3 and 7, no appreciable changes were noted. By day 7, both groups showed notable cognitive improvement over preoperative levels.

Conclusion: Though by day seven they recover, both TIVA and inhalational anesthesia cause cognitive problems following surgery. Early after surgery, TIVA enhances cognitive ability; but both techniques have identical long-term results. Our results imply that to improve cognitive recovery, elderly surgical patients require specially tailored anesthetic management.

Abbreviations: MMSE: Mini-Mental State Examination, MoCA: Montreal Cognitive Assessment, POCD: Postoperative Cognitive Dysfunction, TIVA: total intravenous anesthesia,

Keywords: Total Intravenous Anesthesia; Inhalational Anesthesia; Postoperative Cognitive Dysfunction; Elderly Patients; Cognitive Recovery

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1. INTRODUCTION

The fast expanding population of the elderly people at a global scale, has resulted in an exponentially increase in the number of people aged 65 y and more, needing surgical treatments.[1] This demographic change has posed specific medical problems including preoperative preparation, meticulous surgical management and preventing postoperative complications.[2] Postoperative cognitive dysfunction (POCD) in older patients, is one important problem that has attracted a lot of attention lately.[3] With POCD, a disorder marked by a drop in cognitive ability following surgery, public health and clinical issues have been raised. One possible modifiable element affecting the occurrence of POCD has been proposed as the type of anesthesia used in surgery.[4]

POCD especially affects elderly people for a variety of reasons, including age-related changes in the brain, lower cognitive reserve, and the existence of concomitant diseases.[5] POCD can show up as a loss of memory, poor focus of attention and general cognitive ability; thereby profoundly affecting a person's quality of life, functional independence, and even death. For healthcare professionals, determining ways to reduce the incidence of POCD in older surgical patients has taken priority.[6] Two main strategies have become well-known in anesthesiology: inhaled anesthesia and total intravenous anesthesia (TIVA). While inhalational anesthesia uses volatile anesthetics breathed by the patient, TIVA constitutes the injection of intravenous medications intended to induce and sustain anesthesia.[7] Although both approaches have been applied widely in therapeutic settings, researchers are increasingly interested in their possible effects on the cognitive ability of older patients.[8]

Anesthetesia method choice can affect several elements, including hemodynamic stability, depth of anesthesia, and recovery profile. Recent investigations, however, have started to look at whether the anesthesia option could possibly contribute to the development of POCD in senior patients.[9] This research is especially important, since the fundamental processes by which anesthetics could influence cognitive performance are still poorly understood.[10] A continuing research is focused at the effect of anesthesia on neuroinflammation, oxidative stress, and other neurobiological events. The conflicting findings of current studies make it difficult to arrive to any clear conclusions on the superiority of one anesthesia method over the others in terms of cognitive outcomes.[11] Because of its more favorable pharmacological characteristics—such as lower neuroinflammation and oxidative stress—some studies speculate that TIVA may be linked to a lower risk of POCD.[12] On the other hand, inhalational anesthesia has been connected to possible neurotoxicity, which raises questions regarding its effect on cognitive ability particularly in older individuals with underlying vulnerabilities. The complexity of this subject calls for a thorough review of the relevant literature to better grasp the interaction among TIVA, inhalation anesthesia, and POCD in elderly surgical patients.[13]

The main goal of this research is to evaluate the present data, therefore stressing the limits and strengths of present research as well as the areas of knowledge gap. We want to evaluate whether the cognitive well-being of older surgical patients are effected by one anesthetic technique more than the others.[14, 15] We aimed to add to the current debate on the effects of total intravenous versus inhalational anesthesia on postoperative cognitive dysfunction in elderly patients, so supporting future studies and clinical decision-making in anesthesiology and perioperative care.[16]

2. METHODOLOGY

This study compared the cognitive outcomes associated with the two types of anesthesia in elderly individuals. The study was done in Al-Hilla General Teaching Hospital from January 2024 to June 2024. We enrolled persons ≥ 65 yof age, scheduled for elective surgery, as the subjects of the study. Among the exclusions were a history of cognitive impairment, neurologic disorders, or contraindications to either TIVA or inhalational anesthesia. Patients were randomly allocated either to TIVA group or inhalational anesthesia group, using computer-generated random numbers, therefore ensuring equal representation depending on age and kind of surgery. Preoperative assessment included baseline cognitive function evaluation, comprehensive medical history, physical examination, and demographic data collection.

The inhalational anesthesia group received sevoflurane or desflurane in combination with intravenous opioids. The TIVA group received intravenous propofol and remifentanil. Standardized protocols including the assessment of anesthetic level and hemodynamic parameters guided intraoperative monitoring. Cognitive assessments were performed both preoperatively and postoperatively at intervals of one day, one week, and three months following surgery using authorized tools including the Montreal Cognitive Assessment (MoCA) and the Mini-Mental State Examination (MMSE). To assess the efficacy of the anesthesia types, the study specified primary and secondary results. The primary outcome was POCD incidence, shown by a significant drop in cognitive performance from baseline to postoperative evaluations applying the MMSE and MoCA. Secondary outcomes included the length of

hospital stay, postoperative problems, anesthesia and surgical time, and death within three months following surgery.

Mean, median ± SD for continuous data, and n (%) were utilized for categorical data. SPSS 22 was used for statistical analysis. T test was applied to assess variations between continuous variable mean and median. $P \leq 0.05$ was considered as significant.

3. RESULTS

Table 1 shows the demographic data of the study groups. The TIVA group consisted of 54.7% of patients in age group 60-69 y, while 55.9% of patients were in age group 70-79 y in the inhalational group technique. The number of females and males were equivalent in both groups, statistically no difference (P = 0.6).

There was no statistical difference between ASA physical status (P = 0.9). There was a significant decrease in postoperative cognitive score on day 1 and day 3, compared to preoperative score in patients in the TIVA group, while there was a significant increase in postoperative cognitive score on day 7, compared to preoperative score in these patients (Table 2).

Table 3 shows a significant decrease in postoperative cognitive score on day 1 and 3 than preoperative score in patients in the inhalational group, while there was a significant increase in the score on day 7 than preoperative score in these patients. Significant increase in postoperative cognitive score was noted on day 3 than day 1, on day 7 than day 1 and day 3.

Regarding comparative differences in cognitive scores in the two groups, at day one post-operation there was a significant increase in the cognitive score in TIVA group patients than the inhalation group. While at day 3 and 7, there was no significant difference in the mean of cognitive scores between TIVA and inhalation group (Table 4).

Table 1: Demographic data of patients in both groups

Variables		TIVA Group	Inhalational Group	P-value
Age groups	60-69	58 (54.7)	48 (45.3)	0.15
	70-79	41 (44.1)	52 (55.9)	
Gender	Females	56 (51.9)	52 (48.1)	0.6
	Males	43 (47.3)	48 (52.7)	
ASA PS	I	34 (50.7)	33 (49.3)	0.9
	II	50 (49)	52 (51)	
	III	15 (50)	15 (50)	

Data presented as n (%)

Table 2: Comparative mean cognitive scores pre-operative and postoperative day 1, 3 and 7 in TIVA Group

Day	Mean Cognitive Scores TIVA Group			P-value
	Preoperative	Postop	Difference	
1	28 ± 1.3	26 ± 1.4	2	0.0001
3	28 ± 1.3	27.3 ± 1.4	0.7	
7	28.7 ± 1.3	28	0.7	

Data presented as mean (SD)

Table 3: Comparative mean cognitive scores pre-operative and postoperative day 1, 3 and 7 in inhalational Group

Day	Mean Cognitive Scores Inhalational Group			P-value
	Preoperative	Postop	Difference	
1	28 ± 1	25.2 ± 1.5	2.8	0.0001
3	28 ± 1	27.1 ± 1.3	0.9	
7	28.5 ± 1	28 ± 0.9	0.5	

Data presented as mean (SD)

Table 4: Comparative differences of mean cognitive scores in both groups

Day	TIVA Group	Inhalational Group	P-value
1	26 ± 1.4	25.2 ± 1.5	**0.001**
3	27.3 ± 1.4	27.1 ± 1.3	0.24
7	28.7 ± 0.9	28.5 ± 0.9	0.06

Data presented as mean (SD)

4. DISCUSSION

The present study sought to assess in older individuals, postoperative cognitive dysfunction (POCD) under total intravenous anesthesia (TIVA) vs inhalational anesthesia. Our results show that, compared to preoperative ratings for both TIVA and inhalational anesthesia groups, cognitive scores on postoperative day 1 and day 3 significantly dropped. In both groups, cognitive ratings much raised by postoperative day 7 above preoperative values. On day 1, the TIVA group also showed better cognitive scores than the inhalational anesthesia group; on days 3 and 7, no appreciable changes were noted between the groups. These findings give important new perspectives on how anesthetic method affects POCD and recovery paths in older people. A major concern is postoperative cognitive deterioration, especially in senior persons because of their lower cognitive reserve and increased sensitivity to cognitive deficits following surgery.[17] The first reduction in cognitive function observed on day 1 and day 3 agrees with recent research revealing that early postoperative periods are defined by considerable cognitive impairments.[18] This early reduction might be explained in part by an immediate effect of anesthesia, surgical stress, and the inflammatory response to surgical trauma.[19]

In our study, patients in both anesthesia groups showed a clear rise in cognitive scores by day 7 above their preoperative baseline. This evolution suggests a healing phase in which the first cognitive difficulties become really clear-cut. Among the mechanisms behind this recovery from anesthesia effects, resolution of acute inflammation, and normalizing of physiological parameters disrupted during surgery might be.[20] On postoperative day one, the TIVA group remarkably had substantially higher cognitive evaluations than the inhalational anesthesia group. This outcome supports the idea that TIVA, especially with medications like propofol and remifentanil, would have a greater positive affect on early postoperative cognitive function.[21] given its fast clearance and less chance for residual sedation. Propofol's anti-inflammatory properties and reduced oxidative stress have been shown to have neuroprotective benefits that might contribute to explain the better early cognitive findings in the TIVA group.[22] Nevertheless, by days three and seven the differences in cognitive assessments between the TIVA and inhaled anesthesia groups were not statistically significant. This convergence in cognitive scores over time indicates that although TIVA could offer an early postoperative benefit, the long-term cognitive results of the two anesthesia approaches may be equivalent.

Studies on the long-term cognitive advantages of TIVA versus inhalational anesthesia have produced conflicting findings.[23] The notable rises in cognitive scores from day 1 to day 3 and from day 3 to day 7 in both groups show how dynamically cognitive recovery follows postoperative changes. This increasing trend emphasizes the need of tracking cognitive performance beyond the immediate postoperative time in order to capture the whole recovery path.[24] The absence of appreciable variation in cognitive scores across the groups at days 3 and 7 points to the fact that both anesthesia approaches finally enable recovery to preoperative cognitive levels. This result is important for clinical practice as it shows that the choice of anesthesia technique may be customized depending on other elements including patient comorbidities, surgery type, and anesthesiologist experience, without essentially impacting long-term cognitive results.[25] All things considered, our study adds to the continuous discussion on the best anesthetic strategy to reduce POCD in older patients. Although TIVA seems to have an early cognitive advantage, by the end of the first postoperative week both TIVA and inhaled anesthesia seem to promote cognitive recovery. Future studies should concentrate on determining particular patient groups that could profit most from TIVA as well as investigating other elements that can affect cognitive outcomes following surgery.[26]

5. CONCLUSION

Both TIVA and inhalational anesthesia cause notable postoperative cognitive impairments initially, but by day 7 there is notable improvement. Although TIVA offers an early postoperative cognitive benefit, long-term results for both approaches are very similar. Emphasizing the requirement of thorough perioperative treatment to maximize cognitive recovery in older surgical patients, our results indicate a customized approach to anesthetic management.

6. Data availability

The numerical data generated during this research is available with the authors.

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The study utilized the hospital resources only, and no external or industry funding was involved.

9. Conflict of interest

All of the authors declare no conflict of interest.

10. Authors' contribution

AAS: Concept, manuscript writing, conduction of the study work

ZKAJ: manuscript editing

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