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Postoperative Cognitive Dysfunction after General Anesthesia in Alcoholic and Non-Alcoholic Patients Aged 18–80 Undergoing Non-Cardiac Surgery: A Prospective Observational Study

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ABSTRACT

Background: Postoperative Cognitive Dysfunction (POCD) is a recognized complication of general anesthesia (GA), particularly in vulnerable populations such as the elderly and individuals with a history of alcohol abuse. While POCD has been extensively studied in cardiac surgeries, limited data exists on its incidence following non-cardiac procedures in alcoholics. This study aimed to evaluate and compare the incidence and progression of POCD in alcoholic and non-alcoholic patients aged 18–80 undergoing elective non-cardiac surgeries under GA.

Methods: A prospective observational study was conducted over 18 months in a tertiary care center. A total of 124 male patients, divided equally into alcoholic (Group A) and non-alcoholic (Group NA) groups, were assessed preoperatively and postoperatively using the Mini Mental Status Examination (MMSE) on days 0, 1, 3, and 5. Intraoperative and postoperative parameters were recorded and analyzed.

Results: Baseline MMSE scores were comparable in both groups ($p > 0.05$). However, Group A showed significantly lower MMSE scores at 24 hours ($p < 0.05$) and day 3 ($p < 0.05$) postoperatively, indicating transient POCD, which normalized by day 5. ICU admissions were significantly higher in Group A (19.4%) compared to Group NA (3.2%, $p < 0.05$). Other variables, including demographic, clinical, and intraoperative parameters, were comparable.

Conclusion: Alcoholic patients are at increased risk for early postoperative cognitive impairment and ICU admission following non-cardiac surgery under GA. Preoperative screening and tailored perioperative care are essential in this high-risk group to reduce adverse outcomes.

Keywords: *Alcoholism, Cognitive Dysfunction, General Anesthesia, MMSE, Non-cardiac Surgery*

1. INTRODUCTION

General anesthesia (GA) has revolutionized the safety and complexity of modern surgeries, allowing patients to undergo intricate procedures with minimal discomfort. However, concerns regarding the long-term cognitive effects of GA have surfaced in recent decades, particularly in vulnerable populations like the elderly and those with preexisting conditions such as alcoholism [1,2]. Postoperative Cognitive Dysfunction (POCD) is a recognized complication characterized by a temporary or persistent decline in cognitive abilities following surgery, affecting memory, attention, and executive function. Studies have highlighted the increased susceptibility of both young and elderly patients to POCD, with the underlying mechanisms thought to involve disruption of neural pathways and neuroinflammation caused by GA exposure, particularly through agents acting on GABA and NMDA receptors [3–5].

The cognitive effects of GA are well documented in elderly patients; however, the influence of chronic alcohol consumption remains an area of emerging research. Alcoholics are known to exhibit neurocognitive deficits, particularly in executive functioning and memory, which are further exacerbated by structural changes in the brain, such as frontal lobe atrophy and hypo metabolism [6,7]. Although alcohol-induced cognitive impairments have been well established, it is still unclear whether the interaction between alcohol toxicity and GA could result in more severe POCD outcomes [8]. Alcohol-related brain damage, including alcohol-induced dementia, raises concerns about the exacerbation of neurocognitive decline post-

surgery, especially since alcoholics might present with preexisting cognitive impairments [9,10]. A significant portion of the literature on POCD is centered around cardiac surgery, leaving a gap in understanding the long-term cognitive outcomes in non-cardiac surgeries. Existing studies have demonstrated that advanced age, preexisting cognitive dysfunction, and the severity of illness increase the risk of developing POCD [11,12]. Notably, alcohol abuse has been identified as a risk factor for postoperative delirium, yet its role in the development of POCD, particularly after non-cardiac surgeries, remains underexplored. Furthermore, the interaction of GA with the compromised neural structures in alcoholics may lead to heightened vulnerability, resulting in more pronounced postoperative cognitive dysfunction [13,14].

This study aims to address this gap by comparing the incidence and severity of POCD in alcoholic and non-alcoholic patients aged 18-80 undergoing elective non-cardiac surgeries under GA. Through the use of standardized cognitive assessments, such as the Mini Mental Status Examination (MMSE), we aim to elucidate the differential cognitive outcomes between these two groups, shedding light on alcohol as a potential risk factor for cognitive decline following surgery.

2. METHODOLOY

The study was a prospective, double-blind, observational design conducted at a tertiary care center over 18 months, with approval from the Institutional Ethics Committee. A total of 124 male patients, equally divided into alcoholic and non-alcoholic groups, underwent elective non-cardiac surgeries under general anesthesia lasting 2–4 hours. All procedures followed the Helsinki Declaration, and informed consent was obtained from all participants or their legal representatives. Inclusion criteria included males aged 18–80 years, ASA Grade I or II, scheduled for elective non-cardiac surgery. Patients with preexisting cognitive dysfunction, neuropsychiatric illness, cardiac disease, or undergoing cardiac/neurosurgery were excluded. Preoperative evaluation included clinical examination and investigations such as hemoglobin, glucose, and renal and liver function tests.

Cognitive assessment was done using the Mini Mental Status Examination (MMSE) at baseline, 24 hours, day 3, and day 5 postoperatively, covering domains like orientation, attention, language, and praxis (scored out of 30). A uniform anesthesia protocol was followed for all patients, with standardized monitoring and use of reversal agents (glycopyrrolate and neostigmine) to ensure consistency. Data were compiled in MS Excel and analyzed using IBM SPSS Statistics version 26.0. Quantitative variables were expressed as mean ± standard deviation and compared using the unpaired t-test. Qualitative variables were presented as frequencies and percentages, with intergroup comparisons made using the Chi-square test. A p-value <0.05 was considered statistically significant.

3. RESULTS

The study analyzed data from 124 patients divided into two groups: alcoholic and non-alcoholic individuals undergoing elective non-cardiac surgeries under general anesthesia. Various parameters, including demographic details, clinical characteristics, surgical variables, and cognitive assessments using the Mini Mental Status Examination (MMSE), were systematically evaluated at multiple time points to identify trends and differences between the two groups. The findings are presented in tabular and graphical formats for clarity and comparison.

The baseline characteristics of the two study groups—alcoholic (Group A) and non-alcoholic (Group NA)—were comparable across all measured variables. The mean age was similar between groups (Group A: 45.11 ± 14.70 years; Group NA: 45.55 ± 11.98 years), with the majority of participants falling in the 41–50 age range. Body Mass Index (BMI) distribution was also alike, with most subjects in both groups categorized as overweight. Educational status, ASA grading, and comorbidity profiles including hypertension and diabetes showed no statistically significant differences ($p > 0.05$). A higher proportion of smokers was observed in the alcoholic group (35.5%) compared to the non-alcoholic group (21%), though the difference was not statistically significant. The mean duration of surgery was identical in both groups (175.69 ± 37.95 minutes), ensuring uniformity in operative exposure. Overall, the demographic, clinical, and surgical characteristics of both groups were well-matched, minimizing the potential for confounding in the analysis of postoperative cognitive outcomes.

Table 1. Comparison of study subjects according to their baseline characteristics in Alcoholic and group Non-Alcoholic group

	Group A		Group NA		p-value
	n	%	n	%	
Age (years)					
18-20	2	3.2	1	1.6	
21-30	7	11.3	6	9.7	>.05, NS
31-40	14	22.6	15	24.2	

41-50	19	30.6	21	33.9	
51-60	13	21	13	21	
61-70	3	4.8	4	6.5	
71-80	4	6.5	2	3.2	
Mean ± SD	*45.11 ± 14.70*		*45.55 ± 11.98*		
BMI (kg/m2)					
Normal (18.5-24.9)	25	40.3	22	35.5	>.05, NS
Overweight (25-29.9)	33	53.2	35	56.5	
Obese (≥30)	4	6.5	5	8.1	
Mean ± SD	*25.19 ± 4.10*		*25.93 ± 3.95*		
Education					
Primary	12	19.4	10	16.1	>.05, NS
SSC	9	14.5	8	12.9	
HSC	14	22.6	15	24.2	
Graduation	22	35.5	25	40.3	
Uneducated	5	8.1	4	6.5	
ASA Grading					
I	42	67.7	45	72.6	>.05, NS
II	20	32.3	17	27.4	
Smoking History					
Yes	22	35.5	13	21	>.05, NS
No	40	64.5	49	79	
Comorbidities					
Hypertension	10	16.1	9	14.5	>.05, NS
Diabetes Mellitus	6	9.7	7	11.3	
Mean duration of Surgery (minutes)					
Mean ± SD	*175.69 ± 37.95*		*175.69 ± 37.95*		>.05, NS

The study included a diverse range of elective non-cardiac surgeries performed equally across the Alcoholic (Group A) and Non-Alcoholic (Group NA) groups, with 62 procedures in each. The most common surgeries were laparoscopic cholecystectomy (Group A: 15, Group NA: 11), open reduction and internal fixation (Group A: 5, Group NA: 6), and laparoscopic hernia repair (Group A: 4, Group NA: 5). Other surgeries, such as groin flap division, tympanoplasty, and lipoma removal, were similarly distributed. Certain procedures, including laparoscopic appendectomy and rhinoplasty, were slightly more frequent in Group NA, while others, like modified radical mastoidectomy, were more common in Group A. (Table 2)

Table 2. Type of surgeries performed

Surgery Performed	Alcoholic	Non-alcoholic
Laparoscopic Cholecystectomy	15	11

Open Reduction And Internal Fixation (Humerus, Ulna, Radius)	5	6
Laparoscopic Hernia Repair	4	5
Groin Flap Division	4	5
Tympanoplasty	3	4
Lipoma Removal	4	2
Laparoscopic Umbilical Hernia Repair	3	3
Rhinoplasty	2	4
Laparoscopic Pyelolithotomy	2	3
Modified Radical Mastoidectomy	3	2
Laparoscopic Appendicectomy	1	4
Tonsillectomy	1	3
Exploratory Laparotomy	2	1
Cyst Removal	2	1
Thyroidectomy	2	1
Skin Grafting	2	1
Cranioplasty	2	1
Arthrodesis	1	1
Debridement With Skin Grafting	1	1
Urethroplasty With Buccal Mucosal Graft	1	1
Scalp Tumor Removal	1	1
Colostomy Closure	1	1
Total	**62**	**62**

The comparison of quantitative variables between the Alcoholic (Group A) and Non-Alcoholic (Group NA) groups revealed no statistically significant differences across all parameters. The heart rate (HR) was consistent between the groups at all time points, averaging around 72 beats per minute throughout the intraoperative period. Similarly, systolic blood pressure (SBP) values remained comparable, ranging from 120 mmHg to 123 mmHg, while diastolic blood pressure (DBP) levels were also similar, averaging between 75 mmHg and 79 mmHg. Oxygen saturation (SpO2) levels showed stability in both groups, consistently above 97% at all intervals, with no significant differences observed. The mean duration of analgesia was slightly longer in Group A (224.29 ± 9.27 minutes) compared to Group NA (216.37 ± 7.6 minutes), but this difference was not statistically significant. Overall, the physiological responses to anesthesia and surgery, as assessed by these parameters, were comparable between the two groups, indicating uniform intraoperative management and outcomes. (Table 3)

Table 3. Comparison of quantitative variables at various time intervals

Study variable		**Group A**		**Group NA**		**p value**
		Mean	**SD**	**Mean**	**SD**	
Heart rate (per minute)	0 minute	72.58	8.23	72.48	7.85	>0.05
	15 minutes	73.12	7.29	72.62	7.74	>0.05
	30 minutes	72.92	7.47	72.28	6.9	>0.05
	45 minutes	72.68	7.01	72.77	6.87	>0.05

	60 minutes	72.45	6.95	72.43	7.05	>0.05
	90 minutes	72.67	7.15	72.4	7.68	>0.05
	150 minutes	72.1	6.37	72.05	6.94	>0.05
	210 minutes	72.32	6.08	72.4	7.35	>0.05
	240 minutes	72.57	6.2	72.75	6.07	>0.05
SBP (mmHg)	0 minute	123.5	7.19	123.17	7.25	>0.05
	15 minutes	123.03	7.43	122.03	7.54	>0.05
	30 minutes	122.8	7.66	121.5	7.94	>0.05
	45 minutes	122.57	7.04	121.57	7.22	>0.05
	60 minutes	122.73	6.95	121.33	7.22	>0.05
	90 minutes	121.97	7.28	120.17	7.66	>0.05
	150 minutes	121.93	7.29	120.17	7.1	>0.05
	210 minutes	120.7	7.35	119.33	7.02	>0.05
	240 minutes	120.6	7.05	120.73	7.43	>0.05
DBP (mmHg)	0 minute	78.4	5.37	79.67	5.97	>0.05
	15 minutes	77.37	4.88	78.33	4.75	>0.05
	30 minutes	76.37	4.74	77.4	5.25	>0.05
	45 minutes	75.93	4.86	77.37	5.32	>0.05
	60 minutes	75.7	5.21	77.47	5.73	>0.05
	90 minutes	75.33	5.2	77.7	5.68	>0.05
	150 minutes	77.03	5.46	77.2	5.6	>0.05
	210 minutes	77.63	7.88	76.6	5.64	>0.05
	240 minutes	76.28	7.76	75.6	5.9	>0.05
SpO2	0 minute	98.65	3.32	98.57	3.32	>0.05
	15 minutes	98.25	1.36	98.05	1.14	>0.05
	30 minutes	98.22	1.35	98.08	1.24	>0.05
	45 minutes	98.27	1.19	98.02	1.1	>0.05
	60 minutes	98.28	1.3	97.87	1.27	>0.05
	90 minutes	98.2	1.31	97.95	1.24	>0.05
	150 minutes	98.18	1.46	97.87	1.36	>0.05
	210 minutes	98.12	1.37	97.97	1.21	>0.05
	240 minutes	98.15	1.25	97.85	1.12	>0.05
Duration of Analgesia (mins)		224.29	9.27	216.37	7.6	>0.05

Table 4 indicates between-group comparison of study variables. The requirement for rescue analgesia was slightly higher in the Alcoholic group (Group A: 24.2%) compared to the Non-Alcoholic group (Group NA: 17.7%), but this difference was not statistically significant ($p > 0.05$). Similarly, post-operative complications such as nausea and vomiting were observed in a small percentage of patients, with 4.8% in Group A and 8.1% in Group NA, again showing no significant difference ($p > 0.05$). However, ICU admissions were significantly higher in Group A (19.4%) compared to Group NA (3.2%), with this

difference being statistically significant ($p < 0.05$). This suggests that patients in the Alcoholic group may have experienced more severe post-operative issues requiring intensive care, potentially indicating a higher vulnerability to adverse outcomes in this group.

Table 4. Between group comparison of study variables

Variables		Group A		Group NA		p value
		n	%	n	%	
Requirement of Rescue Analgesic	Rescue analgesia given	15	24.2	11	17.7	>0.05
	Rescue analgesia not given	47	75.8	51	82.3	
Post-operative complications	Nausea & Vomiting	3	4.8	5	8.1	>0.05
	No complications	59	95.2	57	91.9	
ICU Admission	Yes	12	19.4	2	3.2	<0.05*

The between-group comparison of Mini Mental Status Examination (MMSE) scores at various durations (Table 5) highlights notable differences in cognitive function between the Alcoholic (Group A) and Non-Alcoholic (Group NA) groups. At baseline, the MMSE scores were comparable (Group A: 28.16 ± 1.32, Group NA: 28.31 ± 1.29; $p > 0.05$), indicating similar pre-operative cognitive function. However, significant differences emerged postoperatively. At 24 hours post-surgery, the MMSE score was significantly lower in Group A (25.48 ± 1.66) compared to Group NA (27.76 ± 1.25; $p < 0.05$). This trend continued on post-operative day 3, with Group A scoring lower (25.95 ± 1.70) than Group NA (26.98 ± 1.32; $p < 0.05$). By post-operative day 5, the MMSE scores were comparable again between the two groups (Group A: 27.55 ± 1.77, Group NA: 27.61 ± 1.16; $p > 0.05$), indicating recovery in cognitive function in both groups. These results suggest a transient decline in cognitive function in the Alcoholic group during the early post-operative period, which normalizes by day 5, highlighting the temporary impact of surgery and anesthesia on neurocognition in this group.

Table 5. Between group comparison of MMSE at various durations

MMSE		Group A		Group NA		p value
		n	SD	n	SD	
MMSE	Baseline	28.16	1.32	28.31	1.29	>0.05
	Post-op 24 hours	25.48	1.66	27.76	1.25	<0.05*
	Post-op Day 3	25.95	1.7	26.98	1.32	<0.05*
	Post-op Day 5	27.55	1.77	27.61	1.16	>0.05

4. DISCUSSION

This prospective, double-blind, observational study aimed to evaluate the impact of alcohol consumption on postoperative neurocognitive outcomes in patients undergoing elective non-cardiac surgeries under general anesthesia. A total of 124 patients, divided equally into alcoholic (Group A) and non-alcoholic (Group NA) groups, were studied to compare cognitive and clinical outcomes.

The age distribution was similar in both groups, with the majority of patients aged 41–50 years. The mean age was 45.11 ± 14.70 years in Group A and 45.55 ± 11.98 years in Group NA, with no statistically significant difference ($p > 0.05$). This is consistent with studies by Jeenger et al [7] and Kotekar et al [15], which found no significant effect of age on the incidence of postoperative cognitive dysfunction (POCD) but noted an increasing trend with advancing age. Similarly, BMI distribution was comparable, with most patients classified as overweight. The mean BMI was 25.19 ± 4.10 kg/m² in Group A and 25.93 ± 3.95 kg/m² in Group NA, showing no significant differences ($p > 0.05$). These findings align with Rortgen et al. [10], who also reported no association between BMI and cognitive outcomes.

Educational levels and ASA grading were similar between the two groups, with no significant differences observed ($p > 0.05$). Most patients in both groups had completed higher secondary education or graduation. Studies, such as those by Galanakis et al. [16], have identified low education and higher ASA grading as risk factors for postoperative cognitive

impairments, but the balanced distribution in our study minimized such confounding effects. Intraoperative parameters, including heart rate, systolic and diastolic blood pressure, and oxygen saturation, remained stable and comparable in both groups throughout the surgical procedures ($p > 0.05$). The mean duration of surgery was also similar, at 175.69 ± 37.95 minutes in Group A and 172.65 ± 34.24 minutes in Group NA ($p > 0.05$). These results are consistent with the findings of Rortgen et al. [10] and Jeenger et al. [7], who reported stable intraoperative parameters across similar patient populations. The comparable duration of surgery and anesthesia in both groups suggests that differences in cognitive outcomes were likely due to patient-related factors rather than procedural differences.

At baseline, the Mini Mental Status Examination (MMSE) scores were comparable between the two groups (Group A: 28.16 ± 1.32 vs. Group NA: 28.31 ± 1.29, $p > 0.05$). However, significant differences were observed postoperatively. Group A demonstrated significantly lower MMSE scores at 24 hours (25.48 ± 1.66 vs. 27.76 ± 1.25, $p < 0.05$) and on day 3 (25.95 ± 1.70 vs. 26.98 ± 1.32, $p < 0.05$). By day 5, the scores were comparable (Group A: 27.55 ± 1.77 vs. Group NA: 27.61 ± 1.16, $p > 0.05$). These findings align with studies by Hudetz et al. [1] and Jeenger et al. [7], which also reported transient cognitive impairment in alcoholic patients following surgery. The transient nature of POCD in both groups suggests that early postoperative cognitive changes are reversible with time. Postoperative nausea and vomiting (PONV) were slightly more common in Group NA (8.1%) compared to Group A (4.8%), but this difference was not statistically significant ($p > 0.05$). ICU admissions were significantly higher in Group A (19.4%) compared to Group NA (3.2%, $p < 0.05$), with the primary reasons being delayed recovery, excessive blood loss, and sepsis. Similar observations were made by Hudetz et al. [1], who reported a higher rate of ICU admissions in alcoholic patients due to complications such as pulmonary edema and infections.

The requirement for rescue analgesia was higher in Group A (24.2%) than in Group NA (17.7%), although the difference was not statistically significant ($p > 0.05$). Studies by Hudetz et al. [1] and Rortgen et al. [10] similarly reported a higher use of postoperative opioids in alcoholic patients, which could contribute to cognitive impairment due to their sedative effects.

5. CONCLUSION

This study demonstrates that alcoholic patients undergoing surgery under general anesthesia are at a higher risk of transient POCD, with significantly lower MMSE scores in the early postoperative period compared to non-alcoholic patients. Additionally, the higher incidence of ICU admissions in the alcoholic group highlights their increased vulnerability to perioperative complications. These findings highlight the need for preoperative risk stratification and tailored perioperative care in alcoholic patients to improve cognitive and clinical outcomes. Future research should explore the long-term cognitive effects of alcohol and strategies to minimize postoperative risks in this population.

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