

COGNITIVE DYSFUNCTION AMONG PATIENTS UNDERGOING SURGERY WITH GENERAL AND REGIONAL ANAESTHESIA

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ABSTRACT--*Postoperative cognitive changes have been reported for over a century, and anaesthesia has often been mentioned as a possible cause of this problem. The study aimed to assess cognitive dysfunction among patients receiving anaesthesia. 26 patients undergoing surgery with general anaesthesia and 26 patients undergoing surgery with regional anaesthesia were recruited. Informed consent and socio-demographic details were obtained and their cognitive functions were assessed using SMMSE, DSST, TMT-A, and BCRS. The tests were done two days before surgery, on postoperative day one and postoperative day three in patients undergoing surgery with general and regional anaesthesia. The results concluded that both general and regional anaesthesia affects cognition of the individual but the rate of cognitive dysfunction was significantly higher in patients who underwent surgery with general anaesthesia when compared to regional anaesthesia. Further cognitive dysfunction was more postoperatively than before surgery which confirms the fact that postoperative cognitive problems are common in patients following major surgeries.*

Keywords-- *Cognitive Dysfunction, General Anaesthesia, Regional anaesthesia.*

I. INTRODUCTION

Cognition is defined as the mental process of perception, memory, and information processing, which allows the individual to acquire knowledge, solve problems and plan for the future. Cognitive dysfunction is thus impairment of these processes. ^[1] In recent years attention has been focused on cognitive dysfunction affecting patients after surgery where they may discover problems with recalling events and tend to forget names and numbers. This condition is called Post-Operative Cognitive Dysfunction (POCD). ^[2] Due to the subtle nature of POCD, it is often only the patient and/or family who recognize the onset of this problem. Patients with POCD are at an increased risk of death in the first year after surgery. ^[3,4] Research interest has increased since early 2000, especially as more elderly patients can undergo successful minor and major surgeries. It has been recognized that there is no post-operative complication more frequent and of longer duration than POCD. It can result in increased

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morbidity, delayed functional recovery, prolonged hospital stays, and adverse social consequences with reduced quality of life. Hence an attempt is made to study the effect of anaesthesia on cognition.

II. METHODOLOGY:

The cross-sectional study was conducted in a tertiary care teaching hospital after obtaining ethical clearance. The patients under the age group 18 to 60, posted for surgery were recruited from the anaesthesia department. Among them, 26 subjects underwent surgery with general anaesthesia(GA) and 26 subjects with regional anaesthesia(RA). Subjects with pre-existing cognitive deficits or morbidities that causes cognitive dysfunction and with any mental illness were excluded. The study instrument included semi-structured proforma for socio-demographic details, SMMSE(Standardized Mini-Mental Status Examination), DSST(Digital symbol substitution test), TMT-A(Trail making test – A) and BCRS(Brief cognitive rating scales) to assess the cognitive function. The tests were done two days before surgery, on postoperative day one(D1) and postoperative day three(D3) in the patient undergoing surgery with GA and RA.

III. STATISTICAL ANALYSIS:

Data collected were analyzed using SPSS version-20.0. Descriptive (frequency and percentage) and inferential statistics (chi-square test) were used in the study, p-value < 0.05 was considered significant.

IV. RESULTS:

The correlation of the results was done in 3 pairs: Pair 1- Preop D2 & Postop D1, Pair 2- Preop D2 & Postop D3, and Pair 3- Postop D1 & Postop D3.

Based on socio-demographic data:

Among 52 subjects, the majority of them were between the age of 42-53 years. Males who underwent surgery with GA and RA were 40% and 61.1% respectively and females with GA and RA were 75% and 25% respectively who showed significant difference. [TABLE 1]

TABLE 1: SOCIODEMOGRAPHIC VARIABLES OF GA & RA

DATA	GENERAL ANAESTHESIA N (%)	REGIONAL ANAESTHESIA N (%)	TOTAL N(%)	chi-square value (t)	p VALUE
GENDER					
Male	14(38.9%)	22(61.1%)	36(100%)	5.778	0.016*
Female	12(75.0%)	4(25.0%)	16(100%)		
TOTAL	26(50%)	26(50%)	52(100%)		
RELIGION					

Hindu	23(50.0%)	23(50.0%)	46(100%)		
Christian	1(50.0%)	1(50.0%)	2(100%)	0.000	1.000
Muslim	2(50.0%)	2(50.0%)	4(100%)		
TOTAL	26(50%)	26(50%)	52(100%)		
EDUCATION					
Primary school	5(50.0%)	5(50.0%)	10(100%)		
Middle school	11(57.9%)	8(42.1%)	19(100%)	0.951	0.813
High school	6(46.2%)	7(53.8%)	13(100%)		
Graduation/PG	4(40.0%)	6(60.0%)	10(100%)		
TOTAL	26(50%)	26(50%)	52(100%)		
OCCUPATION					
Yes	18(45.0%)	22(55.0%)	40(100%)		
No	8(66.7%)	4(33.3%)	12(100%)	1.733	0.188
TOTAL	26(50%)	26(50%)	52(100%)		

NATURE OF WORK					
Skilled	2(25.0%)	6(75.0%)	8(100%)		
Semiskilled	3(75.0%)	1(25.0%)	4(100%)		
Unskilled	10(43.5%)	13(56.5%)	23(100%)	5.991	0.424
Profession	1(100.0%)	0(0.0%)	1(100%)		
Business	2(50.0%)	2(50.0%)	4(100%)		
Student	1(50.0%)	1(50.0%)	2(100%)		
Unemployed	7(70.0%)	3(30.0%)	10(100%)		
TOTAL	26(50%)	26(50%)	52(100%)		
SOCIO ECONOMIC STATUS					
LSE	10(52.6%)	9(47.4%)	19(100%)		
MSES	14(50.0%)	14(50.0%)	28(100%)	0.253	0.881
USES	2(40.0%)	3(60.0%)	5(100%)		
TOTAL	26(50%)	26(50%)	52(100%)		
MARITAL STATUS					
Married	24(51.1%)	23(48.9%)	47(100%)		
Single	2(40.0%)	3(60.0%)	5(100%)	0.221	0.638
TOTAL	26(50%)	26(50%)	52(100%)		
DOMICILE					
Urban	22(53.7%)	19(46.3%)	41(100%)		
Rural	4(36.4%)	7(63.6%)	11(100%)	1.038	0.308

TOTAL	26(50%)	26(50%)	52(100%)		
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p<0.05 is significant*

Table 2: COGNITIVE TESTS BETWEEN PREOPERATIVE AND POSTOPERATIVE PATIENTS WITH GA:

PAIR & TEST	PRE & POST OP DAYS	MEAN	STANDARD DEVIATION	t VALUE	p VALUE
SMMSE Pair 1	Pre op D2 & Post op D1	27.27	2.219	7.032	1
		23.15	4.086		
SMMSE Pair 2	Pre op D2 & Post op D3	27.27	2.219	6.355	1
		24.08	3.783		
SMMSE Pair 3	Post op D1 & Post op D3	23.15	4.086	2.483	0.02*
		24.08	3.783		
DSST Pair 1	Pre op D2 & Post op D1	68.46	14.236	7.441	1
		53.96	17.943		
DSST Pair 2	Pre op D2 & Post op D3	68.46	14.236	5.241	1
		59.38	16.945		
DSST Pair 3	Post op D1 & Post op D3	53.96	17.943	4.644	1
		59.38	16.945		
TMT-A Pair 1	Pre op D2 & Post op D1	61.54	15.784	4.761	1
		81.54	25.702		
TMT-A Pair 2	Pre op D2 & Post op D3	61.54	15.784	2.957	0.007*
		70.96	21.212		
TMT-A Pair 3	Post op D1 & Post op D3	81.54	25.702	4.848	1
		70.96	21.212		

p<0.05 is significant*

The above table 2, shows the cognitive scales score between preoperative and postoperative patients with GA where the SMMSE score in pair 1 was 27.27 & 23.15 and pair 2 was 27.27 & 24.08 with no significance in both the pairs and pair 3 score was 23.15 & 24.08 with significant difference (p-value 0.02). The DSST score in pair 1 was 68.46 & 53.96, pair 2 was 68.46 & 59.38 and pair 3 was 53.96 & 59.38 with no significance in all the 3 pairs. The TMT-A score in pair 1 was 61.54 & 81.54, pair 3 was 81.54 & 70.96 with no significance in both pairs and pair 2 score was 61.54 & 70.96 with significant difference (p-value 0.007).

Table 3: COGNITIVE TESTS BETWEEN PREOPERATIVE AND POSTOPERATIVE PATIENTS WITH RA:

PAIR & TEST	PRE & POST OP DAYS	MEAN	STANDARD DEVIATION	t VALUE	P VALUE
SMMSE Pair 1	Pre op D2 & Post op D1	27.38	3.275	2.057	0.050*
		26.77	3.658		

SMMSE Pair 2	Pre op D2 & Post op D3	27.38 27.46	3.275 3.547	-0.527	0.603
SMMSE Pair 3	Post op D1 & Post op D3	26.77 27.46	3.658 3.547	-2.327	0.028*
DSST Pair 1	Pre op D2 & Post op D1	67.35 62.08	22.257 23.455	3.126	0.004*
DSST Pair 2	Pre op D2 & Post op D3	67.35 67.77	22.257 22.122	-0.277	0.784
DSST Pair 3	Post op D1 & Post op D3	62.08 67.77	23.455 22.122	-4.796	<0.0001**
TMT-A Pair 1	Pre op D2 & Post op D1	59.08 65.38	20.865 24.475	-2.825	0.009*
TMT-A Pair 2	Pre op D2 & Post op D3	59.08 57.77	20.865 21.844	0.728	0.474
TMT_A Pair 3	Post op D1 & Post op D3	65.38 57.77	24.475 21.844	4.912	<0.0001**

p<0.05 is significant*; p<0.0001 is very high significant**

The above table 3, shows the cognitive scales score between preoperative and postoperative patients with RA where the SMMSE score in pair 1 was 27.38 & 26.77 with significant difference (p-value 0.05), the score in pair 2 was 27.38 & 27.46 with no significance and pair 3 score was 26.77 & 27.46 with significant difference (p-value 0.02). The DSST score in pair 1 was 67.35 & 62.08 with significant difference (p-value 0.004), the score in pair 2 was 67.35 & 67.77 with no significance and the pair 3 score was 62.08 & 67.77 with very high significant difference (p-value <0.0001). The TMT-A score in pair 1 was 59.08 & 65.38 with significant difference (p-value 0.009), the score in pair 2 was 59.08 & 57.77 with no significance and the pair 3 score was 65.38 & 57.77 with very high significant difference (p-value <0.0001).

Table 4: BCRS TEST BETWEEN PREOPERATIVE AND POSTOPERATIVE PATIENTS WITH GA & RA:

PAIR&TEST	PRE & POST OP DAYS	MEAN	STANDARD DEVIATION	t VALUE	P VALUE
BCRS-Axis I Pair 1- GA	Pre op D2 & Post op D1	1.08 2.04	0.272 0.916	-5.116	<0.0001**
BCRS-Axis I Pair 2- GA	Pre op D2 & Post op D3	1.08 1.85	0.272 0.881	1.413	0.170
BCRS-Axis I Pair 3- GA	Post op D1 & Post op D3	2.04 1.85	0.916 0.881	-4.545	<0.0001**
BCRS-Axis II Pair 1-GA	Pre op D2 & Post op D1	1.00 2.00	0.000 0.980	-5.204	<0.0001**

BCRS-Axis II Pair 2-GA	Pre op D2 & Post op D3	1.00 1.38	0.000 0.496	4.500	<0.0001**
BCRS-Axis II Pair 3-GA	Post op D1 & Post op D3	2.00 1.38	0.980 0.496	-3.953	0.001*
BCRS-Axis III Pair 1-GA	Pre op D2 & Post op D1	1.12 2.00	0.431 0.980	-4.738	<0.0001**
BCRS-Axis III Pair 2-GA	Pre op D2 & Post op D3	1.12 1.85	0.431 0.881	1.072	0.294
BCRS-Axis III Pair 3-GA	Post op D1 & Post op D3	2.00 1.85	0.980 0.881	-4.503	<0.0001**
BCRS-Axis IV Pair 1-GA	Pre op D2 & Post op D1	1.08 2.00	0.272 0.980	-5.283	<0.0001**
BCRS-Axis IV Pair 2-GA	Pre op D2 & Post op D3	1.08 1.35	0.272 0.485	-3.035	0.006*
BCRS-Axis IV Pair 3-GA	Post op D1 & Post op D3	2.00 1.35	0.980 0.485	4.474	<0.0001**
BCRS-Axis I Pair 1-RA	Pre op D2 & Post op D1	1.31 1.77	0.679 0.908	-3.333	0.003*
BCRS-Axis I Pair 2-RA	Pre op D2 & Post op D3	1.31 1.35	0.679 0.745	3.070	0.005*
BCRS-Axis I Pair 3-RA	Post op D1 & Post op D3	1.77 1.35	0.908 0.745	-1.000	0.327
BCRS-Axis II Pair 1-RA	Pre op D2 & Post op D1	1.15 1.35	0.462 0.562	-1.729	0.096
BCRS-Axis II Pair 2-RA	Pre op D2 & Post op D3	1.15 1.42	0.462 0.745	-0.700	0.490
BCRS-Axis II Pair 3-RA	Post op D1 & Post op D3	1.35 1.42	0.562 0.745	-2.273	0.032*
BCRS-Axis III Pair 1-RA	Pre op D2 & Post op D1	1.23 1.65	0.587 0.846	-3.070	0.005*
BCRS-Axis III Pair 2-RA	Pre op D2 & Post op D3	1.23 1.50	0.587 0.762	1.690	0.103

BCRS-Axis III Pair 3-RA	Post op D1 & Post op D3	1.65 1.50	0.846 0.762	-2.573	0.016*
BCRS-Axis IV Pair 1-RA	Pre op D2 & Post op D1	1.12 1.46	0.326 0.647	-3.143	0.004*
BCRS-Axis IV Pair 2-RA	Pre op D2 & Post op D3	1.12 1.35	0.326 0.485	-2.739	0.011*
BCRS-Axis IV Pair 3-RA	Post op D1 & Post op D3	1.46 1.35	0.674 0.485	1.364	0.185

p<0.05 is significant*; p<0.0001 is very high significant**

The above table 4, shows the BCRS score between preoperative and postoperative patients with GA and RA:

In the GA group, the BCRS Axis I score in pair 1 was 1.08 & 2.04 with a very high significant difference (p-value <0.0001), in pair 2 was 1.08 & 1.85 with no significance and pair 3 score was 2.04 & 1.85 with very high significant difference (p-value <0.0001). Axis II score in pair 1 was 1.00 & 2.00 and pair 2 was 1.00 & 1.38 with very high significant difference (p-value <0.0001) in both the pairs and pair 3 score was 2.00 & 1.38 with significant difference (p-value 0.001). Axis III score in pair 1 was 1.12 & 2.00 and pair 3 was 2.00 & 1.85 with very high significant difference (p-value <0.0001) in both the pairs and pair 2 score was 1.12 & 1.85 with no significance. Axis IV score in pair 1 was 1.08 & 2.00 and pair 3 was 2.00 & 1.35 with very high significant difference (p-value <0.0001) in both the pairs and pair 2 score was 1.08 & 1.35 with significant difference (p-value 0.006).

In the RA group, the BCRS Axis I score in pair 1 was 1.31 & 1.77 and in pair 2 was 1.31 & 1.35 with significant difference (p-value 0.003 and 0.005) respectively, and pair 3 score was 1.77 & 1.35 with no significance. Axis II score in pair 1 was 1.15 & 1.35 and pair 2 was 1.15 & 1.42 with no significance in both the pairs and pair 3 score was 1.35 & 1.42 with significant difference (p-value 0.03). Axis III score in pair 1 was 1.23 & 1.65 and pair 3 was 1.65 & 1.50 with significant difference (p-value 0.005 and 0.01) respectively and pair 2 score was 1.23 & 1.50 with no significance. Axis IV score in pair 1 was 1.12 & 1.46 and pair 2 was 1.12 & 1.35 with significant difference (p-value 0.004 and 0.01) respectively and pair 3 score was 1.46 & 1.35 with no significance. Axis V showed a score of 1.00 ± 0.000 in all 3 pairs. The correlation and t cannot be computed because the standard error of the difference was 0 in both the groups with GA and RA.

TABLE 5: COMPARISON OF COGNITIVE ASSESSMENT BETWEEN GA & RA PATIENTS

Data	GENERAL ANESTHESIA		REGIONAL ANESTHESIA		t value	p-value
	Mean	Standard deviation	Mean	Standard deviation		
Age	47.69	9.756	47.54	11.006	0.053	0.958

SMMSEPreopD2	27.27	2.219	27.38	3.275	90.149	0.882
SMMSEPostopD1	23.15	4.086	26.77	3.658	3.36	0.001*
SMMSEPostopD3	24.08	3.783	27.46	3.547	3.32	0.002*
DSSTPreopD2	68.46	14.236	67.35	22.257	0.215	0.830
DSSTPostopD1	53.96	17.943	62.08	23.455	1.40	0.167
DSSTPostopD3	59.38	16.945	67.77	22.122	1.53	0.131
TMT PreopD2	61.54	15.784	59.08	20.865	0.480	0.634
TMTPostopD1	81.54	25.702	65.38	24.475	2.321	0.024*
TMTPostopD3	70.96	21.212	57.77	21.844	2.209	0.032*
BCRS Preop D2 Axis I	1.08	0.272	1.31	0.679	-1.608	0.117
BCRS Preop D2 Axis II	1.00	0.000	1.15	0.464	-1.690	0.103
BCRS Preop D2 Axis III	1.12	0.431	1.23	0.587	-0.808	0.423
BCRS Preop D2 Axis IV	1.08	0.272	1.12	0.326	-0.462	0.646
BCRS Preop D2 Axis V	1.00	0.000*	1.00	0.000*	-	-
BCRS Postop D1 Axis I	2.04	0.916	1.77	0.908	1.065	0.292
BCRS Postop D1 Axis II	2.00	0.980	1.35	0.562	2.952	0.005*
BCRS Postop D1 Axis III	2.00	0.980	1.65	0.846	1.364	0.179
BCRS Postop D1 Axis IV	2.00	0.938	1.46	0.647	2.409	0.020*
BCRS Postop D1 Axis V	1.00	0.000*	1.00	0.000*	-	-
BCRS Postop D3 Axis I	1.85	0.881	1.35	0.745	2.210	0.032*
BCRS Postop D3 Axis II	1.38	0.496	1.42	0.758	-0.217	0.829
BCRS Postop D3 Axis III	1.85	0.881	1.50	0.762	1.516	0.136
BCRS Postop D3 Axis IV	1.35	0.485	1.35	0.485	0.000	1.000
BCRS Postop D3 Axis V	1.00	0.000*	1.00	0.000*	-	-

p<0.05 is significant*; p<0.0001 is very high significant**

The above table 5, shows the comparison of cognitive assessment between GA & RA patients where the SMMSE score was considerably less in patients who underwent surgery with GA compared to RA. In DSST, the number of correct responses was less in patients who underwent surgery with GA compared to RA. In TMT-A, the time taken to complete the task was high in patients who underwent surgery with GA compared to RA. The BCRS score was considerably high in patients who underwent surgery with RA compared to GA on preop D2, postop D1 & D3 in all 4 Axis. A significant difference was noted in cognition assessed by SMMSE on postop D1(0.001) and D3 (0.002) and TMT-A on postop D1 (0.024) and D3(0.032) The cognition assessed by BCRS showed significance on postop D3 in Axis I(0.032) and postop D1 in Axis II (0.005) and IV (0.020).

V. DISCUSSION

POCD has been subject to extensive research. In literature, large differences are apparent in methodology such as test batteries, the interval between sessions, endpoints to be analyzed, statistical methods, and how

neuropsychological deficits are defined.^[5] Previous studies that have examined the impact of anaesthesia on cognition have revealed mixed results; some studies report no impact and others report detrimental effects. Hence the present study was planned, in which the majority of individuals were male, educated till middle school, married, employed from the urban background of the middle socioeconomic group. A significant difference was noted only in gender between general and regional anaesthesia groups (p-value 0.016). Many studies have proved POCD among elderly aged >60 years.^[4, 6,7,8] Since it is a known fact, the present study has taken subjects <60 years to test if anaesthetic drugs affect cognition in patients < 60 years also.

The present study showed cognitive dysfunction in both groups who underwent surgery with GA and RA but the rate of cognitive dysfunction was significantly higher in patients who underwent surgery with GA compared to RA and higher on postop D1 when compared to post-op D3. This is consistent with the studies by Tzabar et al,^[9] Anwer et al^[10] and RasmussenLS^[11] However, controversial studies with no significant difference in the incidence of POCD when GA and RA were compared are also reported in the literature.^[12,13,14,5] Studies have shown a decreased incidence of POCD early after surgery with RA when compared to GA which is consistent with the present study. RA also decreases mortality and can be preferred in individuals who are at high risk of POCD.^[11]

The results concerning specific cognitive tests: SMMSE showed a significant difference between patients undergoing surgery with general and regional anaesthesia similar to a study by Bathla et al.^[15] The cognition assessed by TMT-A showed a significant difference in postop D1 & D3 contrary to the study by D. Ro'rtgen et al^[16] which showed no incidence of POCD. The cognition assessed by DSST showed a non-significant difference between two groups similar to the study by D. Ro'rtgen et al.^[16] In the present study the cognition assessed by BCRS in the GA group showed high score corresponding to axis I, II, III & IV on postop D1 compared to preop D2 suggesting very mild cognitive dysfunction and the score was normal on preop D2 and postop D3 suggesting no cognitive decline. RA group showed high score corresponding to axis I, III & IV on postop D1 compared to preop D2 and postop D3 suggesting very mild cognitive dysfunction in postop D1. There is a very high significant difference in the GA group and a significant difference in the RA group in all axis of BCRS between preoperative and postoperative patients. In axis V, the correlation and t couldn't be computed because the standard error of the difference was 0. Hence GA affects all the domains of BCRS like concentration, recent memory, remote memory, orientation, and functioning & self-care, whereas RA affects mostly concentration, remote memory and orientation contrary to study by Bathla et al^[15] where the domain of only concentration showed significance compared to other domains.

VI. LIMITATIONS:

Small sample size, cross-sectional study, and the causal association between different variables couldn't be assessed, lack of a control group to account for the potential practice effect of repetitive testing, the particular anaesthetic agent causing POCD was not studied are the limitations.

VII. SUGGESTIONS:

- There is a severe need for future studies to elucidate the relevant, unexplored pathogenic factors of POCD, the intricate relationship, and interaction among postoperative pain, sleep, and inflammation.

- The lack of a standardized internationally accepted definition of POCD makes the evaluation and comparison between studies difficult and detection of POCD requires a sensitive battery of neuropsychological tests.

VIII. CONCLUSION

Anaesthesia causes significant cognitive dysfunction in the domains of visual search speed, scanning, speed of processing, mental flexibility, executive functioning, concentration, recent memory, and orientation. Both general and regional anaesthesia affects the cognition of the individual but the rate of cognitive dysfunction was significantly higher in patients who underwent surgery with general anaesthesia when compared to regional anaesthesia. Further cognitive dysfunction was more postoperatively than before surgery which confirms the fact that postoperative cognitive problems are common in patients following major surgeries.

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