A comparative study of postoperative cognitive dysfunction in elderly patients undergoing hip surgery after general anaesthesia and combined spinal and epidural anaesthesia

Lalitha Jeenger[1,*], Jitendra Jeenger[2], Suresh Chandra Dulara[3], Adhokshaj Joshi[4]

[1]Assistant Professor, [2]Associate Professor, Geetanjali Medical College & Hospital, Udaipur, Rajasthan, [3]Professor & HOD, [4]Assistant Professor, Govt. Medical College, Kota, Rajasthan

***Corresponding Author:**
Email: jitu24980@gmail.com

Abstract

Background Post-operative cognitive dysfunction (POCD) is the subtle cerebral complication temporally seen following surgery.

Objectives: To compare the influence of general anesthesia (GA) and of combined spinal-epidural anesthesia (CSEA) upon the early post-operative neurocognitive outcome in elderly (60-70 years) subjects undergoing hip surgery. To measure the impacts of preoperatively hospital stay on POCD.

Methods: Total 60, patients were recruited in a prospective, randomized, parallel-group study. They were enrolled and randomized to receive either GA (N= 30) or CSEA (N = 30). All of them were evaluated on the Mini Mental State Examination (MMSE) for their cognitive function and Clock Drawing Test (CDT) for visuospatial function prior to the surgery. The operated patients were re-evaluated 3 days after the surgery on same scales. The data collected were analyzed to assess statistical significance.

Results: We observed no statistically significant difference in cognitive and visuospatial function in both the group pre-operatively, which were comparable with respect to age, sex. We found significant cognitive impairment in patients exposed with GA postoperatively 23.33% whereas in CSEA only 6.66%. Visuospatial function was also significantly affected by GA (26.66%) in comparison to CSEA (13.33%). Duration of preoperative hospital stay didn't affect the neurocongitive functions postoperatively.

Conclusions: We observed a positive difference in cognitive outcome with CSEA as compared to GA. Certain aspects of the cognition were affected to a greater extent like visuospatial functioning with exposure to GA undergoing hip surgery.

Keywords: Postoperative Cognitive Dysfunction, Cognitive Impairment, Visuospatial Function, Mini Mental State Examination, Clock Drawing Test.

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Introduction

In recent years, attention have focused on the cognitive dysfunction among elderly patient's anaesthesia and surgery. Cognitive dysfunction is an impairment of the information-processing abilities of the brain, like attention, perception, verbal abilities, learning and memory and abstract thinking.[1] Increasing age, duration of anaesthesia, episodes of hypoxemia, lack of education, a second operation, postoperative infections, respiratory complications, acute post-operative pain and history of alcohol abuse in elderly patients have been found to be a risk for post-operative cognitive decline and in the domains of visuospatial abilities and executive functions.[2,3,4] Cardiovascular, orthopaedic particularly those with hip and knee and urological intervention carry a higher risk of post-operative cognitive dysfunction (POCD).[5] The objectives of the study to compare the influence of general anaesthesia (GA) or combined spinal-epidural anaesthesia (CSEA) on the early POCD and visuospatial functioning in elderly subjects undergoing hip surgery and the impact of preoperatively hospital stay on post-operative cognitive functions.

Methods

After approval from institutional ethics committee and written informed consent from all the patients, the study was carried out in 60 elderly patients, aged 60-70 years, undergoing elective hip surgery. All the subjects were assessed on American Society of Anaesthesiologist (ASA) grade 1 & 2 going for general anaesthesia and epidural anaesthesia in the department of Anaesthesiology, Govt. Medical College, Kota.

Inclusion criteria and exclusion criteria:

Elderly patients of 60-70 years, who gave the informed consent and fit on ASA grade l & ll. Those patients, who was not having any major systemic illness and scored >23 on Mini Mental Status Examination (MMSE) scale and <3 on Clock Drawing Test (CDT) were labelled as normal cognitive, visuospatial functioning and they were included for present study.[6,7,8,9] Patients with central nervous system diseases, history of Psychiatric disorder, alcoholism or drug dependence, with severe visual or auditory handicap and patients undergoing a second procedure even if unrelated were excluded from the study sample.

Pre-anaesthetic assessment

All patients in this study were subjected to detailed pre-anaesthetic evaluation which included, Presenting complaints, drug history, past history of surgical procedure under general and epidural anaesthesia, history of nausea, retching or vomiting within preceding 24 hours and any major medical illness. Complete general physical examination, ASA grading, blood investigations, urine analysis, ECG, chest X-ray and other laboratory investigations were done as a protocol of the required procedure.

Procedure

This study was conducted on 60 patients divided into 2 groups. Each group was constituted by 30 patients. They had received either general anaesthesia (Group A, N=30) or Combined Spinal and Epidural anaesthesia (Group B, N=30) underwent hip surgery. (All the patients or their caregivers were explained about the purpose of the study and were ensured strict confidentiality.) All patients were assessed day before the hip surgery for their cognitive function by using MMSE and CDT. We have assessed orientation, immediate & recent memory, object identification, comprehension, construction ability and motor coordination by MMSE scale. Total score of MMSE more than 23 were rated as 'intact cognitive functions'. To assess visuospatial organization CDT was used. If CDT score of patients were less than three then it was labelled as intact visuospatial functioning. To assess the impact of preoperative hospitalization on POCD, days of preoperative stay were noted.

After proper identification of patients in the operation theatre, they were subsequently randomized into two groups, groups A and B, to receive GA and CSEA, respectively. Patients were monitored with electrocardiography, pulse oximetry and non-invasive blood pressure measurement. Surgeries were undertaken as a routine procedure and the patients were re-evaluated after 3rd postoperative day for cognitive function by using MMSE and CDT.

Chi- square test and Student's unpaired *t* test were used for statistical analysis of data and conclusion of final results and their significance were drawn.

Results

Group A and Group B were comparable regarding age and sex. The mean age of the patients were 67.13 years for GA group and 66.63 years for CSEA group. Observation table 1, showed no significant difference between both the groups regarding pulse rate, systolic and diastolic blood pressure and oxygen saturation. Table 2, exhibited the comparison of group A and group B over MMSE and CDT scores preoperatively, it was statistically non-significant. Postoperative MMSE score of Group A was 24.37±1.66 and for Group B it was 25.4±1.45. It was statistically Significant (p = 0.013). Group A and group B scored 2.2±1.15 and 1.66±0.8 respectively on CDT. It was also statistically significant (p = 0.043). Table 3, showed severity of cognitive dysfunction on MMSE scores postoperatively, 23(76.66%), 5(16.66%) and 2(6%) patients had no, mild and moderate impairment respectively in Group A. Where as in Group B 28(93.33%) patients had no cognitive impairment and 2(6.66%) patients had mild cognitive impairment. On CDT Scores postoperatively, 22(73.33%), 4(13.33%) and 3(10%) had no, mild and moderate visuospatial function impairment respectively in group A. But in Group B 26(86.66%) patients had no visuospatial function impairment and 4(13.33%) had mild impairment. According to table 4, preoperatively 18(60%) patients stayed upto or less than 5 days in hospital and 12(40%) patients stayed >5 days in hospital from group A. No association has been found amongs the duration of preoperative hospital stay and cognitive and visuospatial functioning impairment in post operative days. Simillarly in group B no significant difference has been found (p=0.277).

Table 1: Distribution of changes in pulse rate, systolic, diastolic blood pressure and oxygen saturation at different intervals in both groups

Study group		Pre-operative	Average Intra-operative	End of surgery	Post-op at 6 hrs	24hrs	48hrs	72hrs
Pluse Rate								
Group- A	Mean ±SD	79.7±7.99	93.17±8.69	78.03±7.049	79.83±7.50	78.2±7.45	77.53±7.7	77.7±7.72
Group-B	Mean ±SD	79.93±8.26	90.73±9.76	78.3±8.00	78.2±8.71	78.27±8.11	78.13±8.95	78.2±8.83
P-Value		p=0.913, (p>0.05)	p=0.311, (p>0.05)	p=0.890, (p>0.05)	p=0.440, (p>0.05)	p=0.972, (p>0.05)	p=0.782, (p>0.05)	p=0.816, (p>0.05)
Systolic Blood Pressure								
Group- A	Mean ±SD	125.3±6.99	134.3±8.28	122.6±7.16	125.7±7.40	124.7±7.88	124.4±6.75	123.2±7.13
Group-B	Mean ±SD	122.1±8.45	133.5±5.84	121.6±6.94	124.7±6.11	123.7±5.92	123.6±6.79	123.4±6.47
P-Value		p=0.115, (p>0.05)	p=0.667, (p>0.05)	p=0.585, (p>0.05)	p=0.570, (p>0.05)	p=0.581, (p>0.05)	p=0.649, (p>0.05)	p=0.910, (p>0.05)
Diastolic Blood Pressure								
Group- A	Mean ±SD	80.67±6.22	87.13±6.38	79.27±5.05	82.4±5.71	81.33±6.11	81.87±5.65	80.87±6.27
Group-B	Mean ±SD	77.73±5.19	88.70±6.05	79.1±5.42	80.93±4.94	80.8±4.85	80.33±5.85	80.2±5.95
P-Value		p=0.052, (p>0.05)	p=0.332, (p>0.05)	p=0.900, (p>0.05)	p=0.291, (p>0.05)	p=0.711, (p>0.05)	p=0.304, (p>0.05)	p=0.673, (p>0.05)
Oxygen Saturation (SPO_2)								
Group- A	Mean ±SD	97.83±0.87	99±0.69	99.27±0.63	97.7±0.87	97.5±0.57	97.67±0.84	97.57±0.62
Group-B	Mean ±SD	97.97±0.92	99.03±0.66	99.23±0.67	97.7±0.83	97.57±0.56	97.63±0.71	97.57±0.62
P-Value		p=0.547 (p>0.05)	p=0.864 (p>0.05)	p=0.813 (p>0.05)	p=1.00 (p>0.05)	p=0.633 (p>0.05)	p=0.843 (p>0.05)	p=1.00 (p>0.05)

Table 2: Distribution of MMSE* and CDT# scores of general anaesthesia and combined epidural-spinal anaesthesia patients pre & postoperatively

Groups	Group A General Anaesthesia (N=30)	Group B Combined Spinal-Epidural Anaesthesia (N=30)	p Value
Cognitive Function on MMSE* Score			
Mean/ SD of MMSE* Scores Preoperatively (1 day before)	26.07±1.66	26.63±1.69	t = 1.295, d/f-58 p=0.201, (p>0.05)
Mean / SD of MMSE* Scores Postoperatively (on 3rd day)	24.37±1.66	25.4±1.45	t = 2.560, d/f-58 p=0.013, (p<0.05)
Change in MMSE* score	1.70	1.23	
Visuospatial Functioning on CDT# Score			
Mean / SD of CDT# Scores Preoperatively (1 day before)	1.467±0.5074	1.433±0.504	t = 0.260, d/f-58 p=0.795, (p>0.05)
Mean / Standard Deviation of CDT# Scores Postoperatively (on 3rd day)	2.2±1.157	1.667±0.8023	t = 2.073, d/f-58 p=0.043, (p<0.05)
Change in CDT# score	0.833	0.234	

* Mini Mental Status Examination
# Clock Drawing Test

Table 3: Distribution according to severity of cognitive function impairment and visuospatial functioning impairment in general anaesthesia and combined epidural-spinal anaesthesia patients

Severity of Cognitive Function	Group A General Anaesthesia (N=30)		Group B Combined Spinal-Epidural Anaesthesia (N=30)	
	Preoperative (1 day before)	Postoperative (on 3rd day)	Preoperative (1 day before)	Postoperative (on 3rd day)
Cognitive Function on MMSE* Score				
No impairment MMSE* 24-30	30 (100%)	23(76.66%)	30(100%)	28(93.33%)
Mild Impairment MMSE* 20-23	--	5(16.66%)	--	2(6.66%)
Moderate Impairment MMSE* 10-19	--	2(6.66%)	--	--
Severe Impairment MMSE* 0-9	--	--	--	--
Visuospatial Functioning on CDT# Score				
No impairment CDT# 1-2	30 (100%)	22(73.33%)	30(100%)	26(86.66%)
Mild Impairment CDT# 3	--	4(13.33%)	--	4(13.33%)
Moderate Impairment CDT# 4	--	3(10%)	--	Nil
Severe Impairment CDT# 5-6	--	1(3.33%)	--	Nil

* Mini Mental Status Examination
# Clock Drawing Test

Table 4: Distribution according to preoperative hospital stay and cognitive and visuospatial functioning impairment in general and combined epidural spinal anaesthesia

Distribution of Hospital Stay and Cognitive Impairment	Hospital Stay and Number of Patients	Mean of MMSE Scores	Standard Deviation	p Value
MMSE*				
Postoperative Group A	=/<5 18(60%)	24.56	2.281	t= 0.616, d/f-28, p=0.543, (p> 0.05)
	>5 12(40%)	24	2.663	
Postoperative Group B	=/<5 17(56.66%)	25.53	1.281	t= 0.520, d/f-28, p=0.607, (p> 0.05)
	>5 13(43.33%)	25.23	1.878	
CDT#				
Postoperative Group A	=/<5 18(60%)	1.944	1.162	t= 0.856, d/f-28, p=0.399, p> 0.05)
	>5 12(40%)	2.333	1.303	
Postoperative Group B	=/<5 17(56.66%)	1.706	0.686	t= 1.108, d/f-28, p=0.277, (p> 0.05)
	>5 13(43.33%)	1.923	0.177	

* Mini Mental Status Examination
# Clock Drawing Test

Discussion

Cognition is defined as the mental processes of orientation, perception, memory, and information processing, which allows the individual to acquire knowledge, solve problems, and plan for the future. It comprises the mental process required for everyday living and should not be confused with intelligence. Cognitive dysfunction is thus impairment of this processes.[10] It is usually expressed by patients in terms of failure to perform simple cognitive tasks.

The incidence of POCD ranges from 5% to 15%.[11] In certain high-risk group it may exceed to 16-62% with an average of 35% such as hip fracture patients.[12] POCD is more complicated to describe, as the true incidence can be masked by attrition of the worst cases. Additionally, POCD can improve with time, so incidence must be described at a particular interval after surgery. Currently, it seems that POCD incidence is high initially in older patients i.e. in 25% patients at two–ten days with gradual resolution in 10% of patients at three months, 5% at six months, and 1% at one year.[13] At one year, the cognitive function is indistinguishable from matched controls.

This study had been designed to find the incidence of cognitive impairment in GA and CSEA exposed patients and impact of hospital stay on POCD, These type of researches may help to reduce the incidence POCD and in better outcome for postoperative geriatric population. In this context, an effort had been made in the present study. We have selected age of patients between 60 to 70 years because it had been seen that cognitive impairment is more common in geriatric age group. Galanakis P et al found that postoperative acute confusional state increases with higher age.[14]

Our result showed that postoperatively on 3rd day, patients who received GA had more chances to develop cognitive impairment as compared to CSEA. POCD is common in post cardiac surgeries but major non cardiac surgeries are also associated with post-operative cognitive complications.[15] Rasmussen LS et al included patients aged over 60 years undergoing major non-cardiac surgery and they found that 19.7% patients had POCD at seventh day after GA and in 12.5% patients after regional anaesthesia.[16] After three months of operation, POCD was present in 14.3% patients after general anaesthesia verses 13.9% after regional anaesthesia. The incidence of POCD after 1 week was significantly greater with general anaesthesia.

Clock Drawing Test is a validated tool which helps to assess cognitive function of individual especially visuospatial function which is governed by Parietal lobe. We found statistically significant difference of CDT scores on third day postoperatively. Ancelin ML et al observed that age, low educational level, preoperative cognitive impairment, depression and general anaesthesia are also the risk factors for POCD.[17] They studied effects of GA on the incidence of cognitive dysfunction after orthopaedic surgery in 140 patients over the age of 64 years. Postoperative cognitive decline persisted for three months in 56% of subjects. On detailed evaluation of cognitive function they came to know the dysfunction was limited to verbal, visuospatial, semantic abilities, secondary and implicit memory.

Earlier studies were lacking in evaluation of severity of cognitive dysfunction. We have observed that GA was associated with higher level of cognitive impairment in comparison to CSEA. Mild to moderate cognitive impairment in most of the POCD patients occured post GA but post CSEA no or mild impairment was noticed. Anwar HM et al in 2006, compared the effect of general anaesthesia or regional analgesia on postoperative cognitive function.[18] Their results indicated that GA poses a significant risk for the occurrence of early POCD in elderly patients that can persist for three days after surgery. Our findings are contradictory with Papaioannou A et al.[19] That the type of anaesthesia did not affect its incidence. The only important factor for the development of delirium was pre-existing cardiovascular disease irrespective of anaesthesia type ($P < 0.025$).

According to severity of visuospatial functioning in our study, in group A, 26.66% patients had visuospatial functioning impairment postoperatively on 3rd day, 4 patients had mild and 3 patients had moderate impairment and only 1 patient had severe impairment. When compared to group B only 13.33% patients developed visuospatial impairment of mild category.

Mandal S, Basu M et al. compared the influence of either general anesthesia or epidural anesthesia on the early post-operative neurocognitive outcome in elderly (>59 years) subjects undergoing hip and knee surgery.[20] The subjects were screened using the MMSE, with components of the Kolkata Cognitive Screening Battery. The operated patients were re-evaluated 1 week after surgery using the same scale. Grossly, a significant difference was seen between the two groups with respect to the perioperative changes in verbal fluency categories and MMSE scores. However, these differences were not significant after the application of the Bonferroni correction for multiple analyses.

Marie-Laure Ancelin et al investigated the long-term effects of anesthesia on cognitive functioning after orthopedic surgery in elderly patients.[21] The observer found a clear dissociation effect for several areas of visuospatial functioning which persisted up to the 13-month follow-up. Amongst all cognitive function, visuospatial functioning impairment lasted for longer time. The observation of only minor differences between persons operated by general and regional anaesthesia makes it difficult to attribute these changes directly to the anaesthetic agents themselves, suggesting that cognitive dysfunction may be attributable at least in part to peri-operative conditions, notably stress and glucocorticoid exposure.

Duration of preoperative hospitalization was not associated with cognitive and visuospatial functioning impairment according to our observation. Galankis P et al reported risk factors for postoperative acute confusional state (ACS) like higher age, prior cognitive impairment as measured by MMSE, depression, low educational level, preoperative abnormal sodium, living in nursing home, vision or hearing impairment, higher comorbidity, regular use of psychotropic drugs before admission, fracture on admission, preoperative leucocytosis.[14] Postler A and colleague have mentioned many risk factors which can cause POCD but not preoperative hospital stay. Whereas postoperative hospital stay in older patients is at an increased risk for adverse effects.[22]

Limitations

It could have been better if we followed the cases at 3 and 6 months postoperative period respectively to delineate the prognosis of the dysfunctions because early POCD is largely reversible when followed over a period. Also, as there are many risk factors for POCD and all of them were not taken care of, the results may be confounding. It would have been better if we could have extended our study to incorporate social factors related to the research.

Sample size was very small, Sample was derived from tertiary care hospital, and details of other cognitive functions were not evaluated in the study so findings cannot be generalized.

Conclusion

Our study showed a significant statistical difference in cognitive functions in patients undergoing hip and knee surgery following GA or CSEA. Despite several attempts, no gold standard treatment has been devised for POCD. Numerous techniques have been proposed to minimize the risk and reduce perioperative cerebral damage. Such suggestions are rarely evidence based and merely empirically developed strategies.

The main objective is to maintain a stable hemodynamic and physiological state, including ventilation, metabolism and blood chemistry. Hypoxia, hypo or hypercapnoea, hypo or hyperglycemia and alteration of sodium amplify the clinical impact of acute vascular cerebral damage and thus their prevention might have a role in reducing the incidence of POCD.

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