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Postoperative cognitive dysfunction in geriatric patients after orthopedic surgery

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The aim of our study was to find out the changes of cognitive functions of geriatric patients after orthopedic surgery and when these differences are marked. We also tried to find out factors, which have influence on the results of common mental activity, to estimate the dynamics of mental activity and to choose the most optimal intervals of estimation. The population of our investigation consisted of 25 consecutive adult patients, undergoing orthopedic operation, applying regional anesthesia. Neurophysiological assessment where all patients underwent neurophysiological tests consisted of the Mini-mental State Examination (MMSE), 6 Item Cognitive Impairment test (6CIT), Trail-making test – a neuropsychological test of visual attention and task switching. Patients were tested the day before the surgery (MMSE1, 6CIT1, TMT1), on the day of the surgery (MMSE2, 6CIT2, TMT2) and on the third day after the surgery (MMSE3, 6CIT3, TMT3). The day before the surgery reveals that results of MMSE1, 6CIT1 tests were better in a group of younger patients. We found that the results of the MMSE test were significantly worse 3 days after the surgery than those before the procedure in the A group, $p = 0.016$. The biggest digression was fixed in "copying" and "repeating" after the surgery intervention, $p = 0.01$, $p = 0.04$. The orientation in time significantly decreased in the group B after the surgery, $p = 0.00$. MMSE, 6CIT, TMT test results were significantlt worse in older patients rather than younger ones 3 days after the surgery. We set that the elderly have a significantly shorter duration of education. Younger patients and patients with a longer studying period achieved better results of tests. The results mean that age and lasting of education are significant predictors of POCD. Our pilot study confirmed that POCD develops for older patients, undergoing neuroaxial anesthesia for orthopedic surgery. It is very important to continue studies and reveal how to decrease POCD events, keep the quality of life.

Key words: postoperative cognitive dysfunction, orthopedic surgery, complication, geriatric patient, Mini-mental State Examination, 6 Item Cognitive Impairment test, Trail-making test, age, anesthesia, education

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INTRODUCTION

Nowadays the quality of life of the patient after surgical treatment is as important as the absence of postoperative complications and mortality rates. Neuropsychological complications, such as memory, concentration, language and comprehension disturbances, are frequent phenomena occurring early postoperatively and their incidence varies from 30 to 60% (1, 2). Neuropsychological complications are rarely detected and are often taken as a natural part of the postoperative course. Postoperative cognitive dysfunction (POCD) in the elderly patient is an unwanted complication of the postoperative period, relatively frequent and most of the time underestimated. POCD is particularly characterized, but not only, by the alteration of memory and concentration performances. It is, for the time being, only detectable through the usage of neuropsychological tests (3). POCD affects activities of daily living and reduces the quality of life, increases morbidity and mortality (19).

The aim of the study was to find out the changes of cognitive functions (CF) of geriatric patients after orthopedic surgery and how cognitive functions change after surgery. We also aimed at finding out factors, which have influence on the results of common mental activity, estimating the dynamics of mental activity and choosing the most optimal intervals of estimation.

MATERIALS AND METHODS

The population of our investigation consisted of 25 consecutive adult patients, undergoing orthopedic operation, applying neuroaxial anesthesia, at the Hospital of Lithuanian University of Health Sciences, Kaunas Clinics. The informed consent was obtained from all of the patients. The following exclusion criteria were applied: age less than 65 years, pre-existing neurological impairment or evident cognitive decline, physical condition disabling the performance of neurophysiological tests and inability to read and speak Lithuanian. Demographic, operative data were recorded using the standardized data entry form.

Neurophysiological assessment where all patients underwent neurophysiological tests consisted of the Mini-mental State Examination (MMSE), 6 Item Cognitive Impairment test (6CIT), Trail-making test – a neuropsychological test of visual attention and task switching. Patients with severe cognitive impairment (MMSE score, <15) were excluded to reduce the difficulty of demarcating POCD from dementia. Although other methods of POCD assessment exist, MMSE is reliable in the perioperative period when used by the trained personnel. Patients were tested the day before surgery (MMSE1, 6CIT1, TMT1), on the day of the surgery (MMSE2, 6CIT2, TMT2) and on the third day after the surgery (MMSE3, 6CIT3, TMT3). To optimize the reliability of the evaluation, the cognitive test was done for one patient by the same physician. Patients were divided into two groups: A ≥ 75 years old and B < 75 years. Preliminary medical, social case histories of patients as well as blood samples were obtained before the surgery. We assessed the ASA physical status of patients, extent of infuse therapy, quantity of blood losing, and registered the duration of surgery. Statistical analysis was performed by using the software STATISTICA, Version 8.0. Data are expressed as the mean ± SD. For parametric samples the Student's t-test was used. One-way analysis of variance (ANOVA) was used to compare means. A value of $p < 0.05$ was considered statistically significant.

RESULTS

The study consists of 25 patients between 66 and 86 years old: 9 (26%) male, 16 (64%) female. A total of 25 patients were randomized with n = 12 in the A group and n = 13 in the B group. The medical, demographic data of both groups are shown in Table 1.

Firstly, we tried to compare (CF) of patients in both groups (static component). It was also very important to set the age and education correlation with the results of tests (Tables 3 and 4). We chose several tests to decrease the risk of test acquisition. The complex of tests let us to observe the dynamics, to set the decreasing of mental activity, to mark the period when the decreasing of mental activity is the most significant.

The day before the surgery reveals that results of MMSE1, 6CIT1 tests were better in a group of younger patients (Figs. 1–3, Table 3). Intraoperative data (Table 2) demonstrate two significant differences between the groups. The first difference, the duration of surgery, was somewhat longer in

Table 1. Demographic, blood sample data

Registered before surgery	A group ≥ 75 years	B group < 75 years		p value
Age average	79.1 ± 1.89	68.2 ± 1.28	years	p < 0.01
Lasting of education	4.3 ± 0.83	9.1 ± 3.8	years	p < 0.01
Comorbidity average	1.46 ± 0.74	1.40 ± 0.44		p = 0.89
Past surgery	0.67 ± 0.27	0.9 ± 0.23		p = 0.14
Hb	122 ± 11.4	134 ± 9.17	g/l	p = 0.20
Ht	32.73 ± 6.4	34.6 ± 5.4	%	p = 0.70
APTT	36.5 ± 3.1	32.8 ± 3.4	sec.	p = 0.09
SPA	105.2 ± 8.2	94 ± 7.3	%	p = 0.07
INR	0.96 ± 0.04	1.01 ± 0.08		p = 0.06
ASA	2	1.8		p = 0.1

Table 2. Perioperative data

	A group ≥ 75 years	B group < 75 years		
Duration of anaesthesia	160 ± 23	111 ± 24	min	p = 0.03
Volume of infusion	2 290 ± 220	1 961 ± 192	ml	p = 0.06
Blood loss	330 ± 99	240 ± 60	ml	p = 0.16

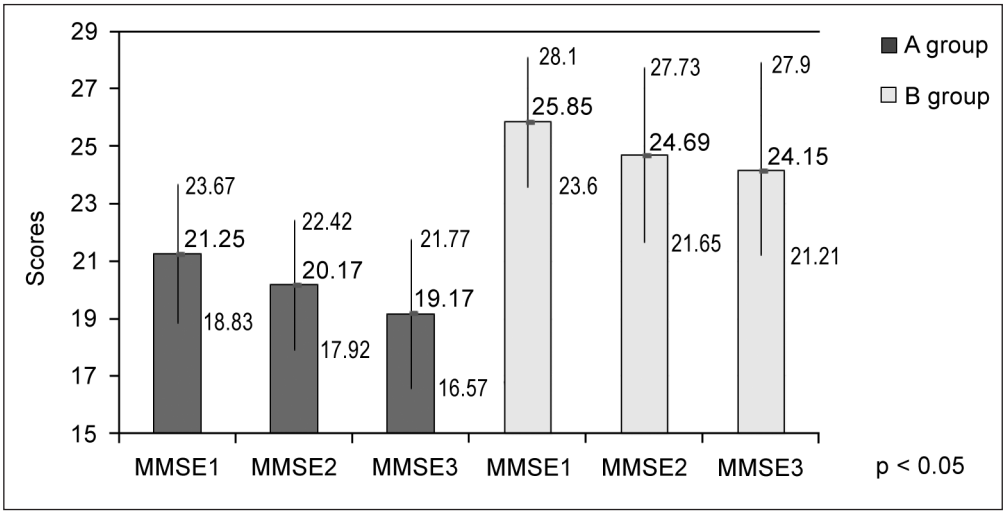

Fig. 1. Comparison of MMSE test results

the A group (p = 0.03), the second difference, the volume of infusion therapy, was bigger in the A group (p = 0.06).

The second day MMSE2, 6CIT2, TMT2 results were similar to the first day results in each group, but there were significant differences between younger and elder patients (Table 3). Every patient wrote significantly worse on the second day of the study, comparing with the day before the surgery in both groups: A group p = 0.03, B group p = 0.04.

The same tests were repeated after 3 days. Results were compared with the previous ones. We

Table 3. Comparison of test results

Tests in A and B groups	p value
MMSE1	p = 0.006
MMSE2	p = 0.017
MMSE3	p = 0.011
6CIT1	p = 0.002
6CIT2	p = 0.003
6CIT3	p < 0.001
TMT1	p = 0.082
TMT2	p = 0.002
TMT3	p = 0.001

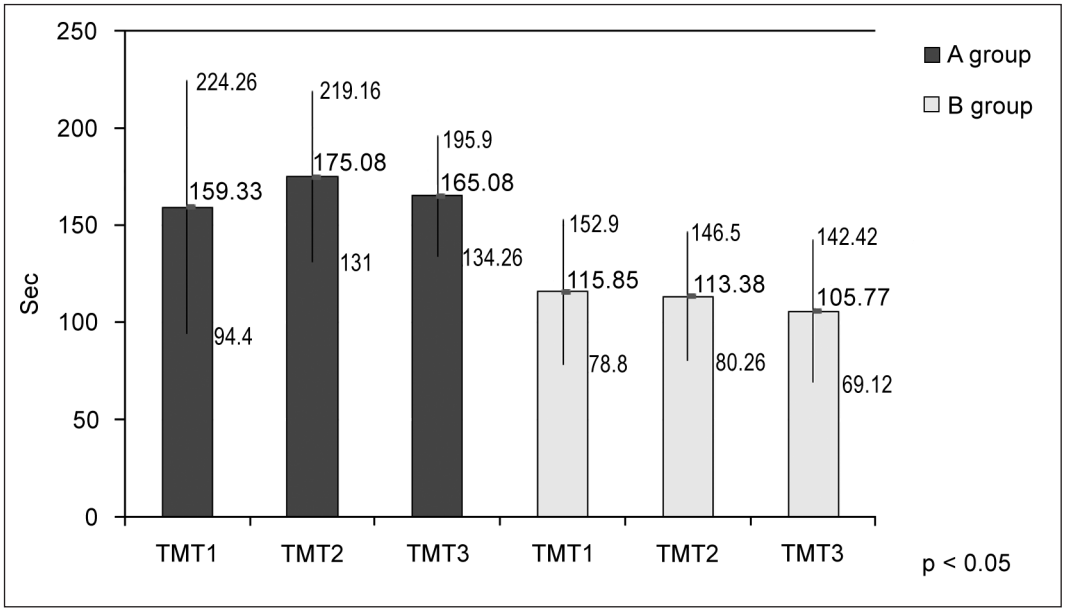

Fig. 2. Comparison of TMT test results

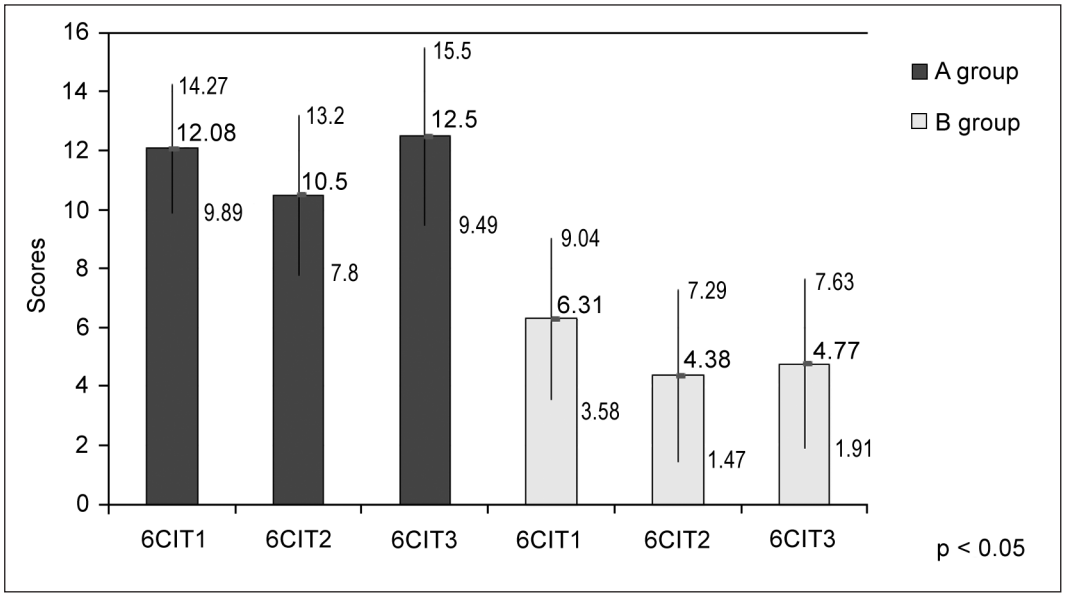

Fig. 3. Comparison of 6CIT test results

found that the results of the MMSE test were significantly worse 3 days after surgery than those before the procedure in the A group, p = 0.016 (Fig. 1). The biggest regression was fixed in "copying" and "repeating" test components after the surgery intervention, p = 0.01, p = 0.04 (Fig. 1). The orientation in time significantly decreased in the group B after the surgery, p = 0.00. MMSE, 6CIT, TMT test results were significantly worse in older patients rather than younger patients 3 days after the surgery.

DISCUSSION

POCD is a severe and life-threatening complication after an operation. The mobilization of the patient is difficult and, therefore, the stay of the patient in the hospital is extended and the resulting immobilization is associated with further complications (e. g. decubitus, pneumonia, or thrombosis) (4). POCD is often associated with cardiac surgery, but less is known about the prevalence of this problem after other types of surgery (18). POCD is common

in adult patients of all ages at hospital discharge after major noncardiac surgery, but only the elderly (aged 60 or older) are at significant risk for long-term cognitive problems (20). Patients with POCD are at an increased risk of death in the first year after surgery (5). POCD is statistically and conventionally defined by comparing the preoperative cognitive performance to the postoperative one, at different moments in time. It has been suggested that intraoperative neuraxial (spinal, epidural) anaesthesia may decrease postoperative cognitive dysfunction when compared with general anaesthesia, but the issue remains controversial. A systematic review of 196 abstracts and 24 trials published between 1966 and 2003 has shown that the use of intraoperative neuraxial anaesthesia does not appear to decrease the incidence of postoperative cognitive dysfunction when compared with general anesthesia. The risk factors shown to be involved in the POCD development after both cardiac and non-cardiac surgery are old age, a low educational level and recently demonstrated history of stroke (6). Propositions were confirmed in our study too.

This study shows that in elderly patients undergoing hip fracture repair under regional (spinal) anesthesia, MMSE results are significantly worse after surgery than before. MMSE test reveals the significant cognitive functions regression, particularly on the third day after surgery. Results of the second day of testing show the decreased ability to write. In the older patients' group, the biggest regression is in the following parts of the test: "copying" and "repeating" on the third day after surgery. In the younger patients' group, up to 75 years, we revealed a significant regressed ability of writing on the day of surgery and poor orientation in time after the surgery. MMSE test results of patients over 75 years old were significantly lower after the surgery than before the surgery, even with a smooth postoperative course. The 6CIT test did not show a reduction of mental activity and we associated it with potential learning issues. Moreover, we revealed that the patients of the group A performed all tests significantly better than older patients except TMT1 (Table 3). Patients, who obtained MMSE1 test scores ≥25, were younger. We believe that different results might have influenced the demographic characteristics such as age, duration of education, longer duration of anesthesia. We set a significant correlation between age, education and with results of tests (Table 4).

The mechanism whereby intraoperative agencies affect the occurrence of POCD in elderly patients has not been elucidated. Hypotheses range from a cerebrovascular origin due to decreased perfusion. In contemporary medical literature occurrence of postoperative cognitive decline is explained mainly by free mechanisms: intraoperative cerebral microembolism, hypoperfusion and systemic inflammatory response, ischemic injury being the common pathway causing cerebral dysfunction (7). The neurobiologic mechanisms underlying delirium are not definitively understood, but several potential mechanisms have been hypothesized. The thalamus is the gateway for sensory input, the abnormal processing of which may

Table 4. Correlation between demographic data and test results

	Mean	Std. Dv.	r	p
Age	74.58	6.16		
Education	6.52	3.97	–0.61	<0.01
Age	74.58	6.16		
MMSE	23.35	4.00	–0.51	<0.01
Age	74.58	6.16		
6CIT	7.58	4.99	0.46	<0.01
Age	74.58	6.16		
TMT	143.66	74.26	0.24	0.049
Education	6.52	3.96		
MMSE	23.35	4.00	0.50	<0.01
Education	6.52	3.96		
6CIT	7.58	4.98	–0.50	<0.01
Education	6.52	3.96		
TMT	143.66	74.26	–0.39	<0.01

characterize the hyperarousal of the mental disorder state (9). Moreover, the thalamus is thought to play an important role in anaesthetic-induced loss of consciousness (10), intravenous and volatile anaesthetics alter thalamic function, primarily through action at inhibitory γ-aminobutyric acid-mediated synapses (11–15, 17) and γ-aminobutyric acid-mediated tone is reduced with aging (16). Furthermore, brief exposures of thalamic neurons to drugs may have longer-lasting effects. The results of the current study are consistent with these more fundamental observations. Recently it was shown that orthopedic surgery is accompanied by cerebral microemboli in almost 100% of cases. It should be noted that microemboli were registered at cerebral vessels not only intraoperatively, but also during first days after cardiac or orthopedic surgery (8).

CONCLUSIONS

1. This study confirmed that POCD appears for geriatric patients after neuroaxial anaesthesia (epidural, spinal).

2. Age and lasting of education are significant predictors of POCD. Younger and with longer studying period patients achieved better results of tests.

3. We suppose that it is very important not to delay endoprosthesis of knee or hip after appearance of indications. Aging increases the possibility of POCD after orthopedic surgeries under neuroaxial anaesthesia.

It is very important to continue studies and reveal how to decrease POCD events, keep the quality of life.

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Arūnas Gelmanas, Tomas Bukauskas,
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GERIATRINIŲ PACIENTŲ PAŽINTINIŲ FUNKCIJŲ SUTRIKIMAS PO ORTOPEDINIŲ OPERACIJŲ

Santrauka

Pažintinių funkcijų sutrikimas yra dažna vyresnių pacientų pooperacinė komplikacija – ypač po ortopedinių bei kardiochirurginių operacijų. Šis sutrikimas dažnai nepakankamai įvertinamas, nes yra nustatomas tik specialiais testais. Šiame straipsnyje norime parodyti geriatrinių pacientų pažintinių funkcijų sutrikimą lemiančius predisponuojančius veiksnius bei šių funkcijų pokytį po ortopedinių operacijų. Nagrinėjamą imtį sudarė 25 pacientai, kuriems taikant spinalinę anesteziją Lietuvos sveikatos mokslų universiteto ligoninėje Kauno klinikose buvo atliekamos ortopedinės operacijos. Vyresni nei 65 metų amžiaus pacientai buvo vertinami panaudojant protinės būklės mini tyrimą, 6 punktų pažintinių funkcijų sutrikimo testą, taškų suvedžiojimo testą. Mūsų nagrinėtos imties visi tiriamieji dėl galimų neuropsichologinių komplikacijų atliekant medicinines procedūras priklausė didesnės rizikos grupei (amžius >65 m.). Gauti rezultatai rodo, kad pacientų, vyresnių nei 76 metai, pažintinių funkcijų testų rezultatai po ortopedinių operacijų patikimai prastesni nei iki operacijos. Iki 75 m. amžiaus pacientų grupėje nustatytas patikimai pablogėjęs gebėjimas rašyti operacijos dieną bei orientavimasis laike praėjus 3 dienoms po operacijos. Palyginus jaunesnių ir vyresnių pacientų grupes nustatyta, kad jaunesni pacientai geriau atlieka testus nei vyresnieji. Rasta reikšminga koreliacija tarp amžiaus, išsilavinimo bei testų rezultatų. Manome, kad skirtingus rezultatus galėjo nulemti amžius, skirtingas išsilavinimas ir ilgesnė anestezijos trukmė. Apibendrinant galima teigti, jog vyresnis amžius ir išsilavinimas yra patikimi prognostiniai kognityvinių sutrikimų veiksniai. Šis tyrimas patvirtina, kad pažintinių funkcijų sutrikimas yra aktuali vyresnių pacientų problema.

Raktažodžiai: pažintinės funkcijos, komplikacijos, ortopedinė operacija, geriatrinis pacientas, protinės būklės mini tyrimas, 6 punktų pažintinių funkcijų sutrikimo testas, taškų suvedžiojimo testas, išsilavinimas, amžius, anestezija