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COGNITIVE PROBLEMS IN PATIENTS WITH ISCHAEMIC HEART DISEASE IN THE EARLY POSTOPERATIVE PERIOD AFTER CORONARY ARTERY BYPASS GRAFTING

M. Petrova, S. Prokopenko, O. Eryomina, E. Mozheyko, D. Kaskaeva, O. Gavrilyuk
Krasnoyarsk State Medical University, Krasnoyarsk, Russia

Abstract

Postoperative cognitive dysfunction (POCD) is the most common complication that may occur after direct myocardial revascularisation under the circumstances of artificial circulation (AC). This fact is of special importance for patients of productive age, as development of POCD complicates the restoration process and reduces efficiency of rehabilitation. The aim of the study was to investigate the incidence of cognitive impairment in the early postoperative period under the circumstances of AC. The research was carried out on the basis of the Federal State Budgetary Institution of Federal Cardiovascular Surgery Centre, Krasnoyarsk. 146 patients with ischaemic heart disease (IHD) and scheduled for coronary artery bypass grafting (CABG) were enrolled in the study. All the patients underwent CABG in the conditions of AC. After the operation all the patients were observed in the intensive care unit by means of ongoing ECG, haemodynamic and respiratory monitoring. Neuropsychological testing performed 8-10 days after surgery revealed the presence of POCD. According to the present knowledge, there is no generally accepted concept of POCD. This fact complicates elaboration of rehabilitation and follow-up strategies for patients with POCD. These issues require interdisciplinary investigation, further development of methods of diagnostics, prophylaxis and treatment of POCD in patients after CABG.

Gavrilyuk Oksana Akeksandrovna – Candidate of pedagogical sciences, Associate professor, Head of the Department of Latin and Foreign Languages, Krasnoyarsk State Medical University;
Address: 1, P. Zeleznyaka street, Krasnoyarsk, 660022; phone: +7(391)2271212;
E-mail: oksana.gavrilyuk@mail.ru
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Relevance

Central nervous system impairment is one of the main complications after coronary artery bypass grafting (CABG). Cardiac surgeries are associated with increased risk of neurologic complications development. Over several last decades, cardiac surgery and cardiac anaesthesiology have attained substantial advance in the matter of patients’ safety provision. Neurologic complications incidence after surgery performed in the circumstances of artificial circulation (AC) has been reduced to a minimum. The number of massive central nervous system disorders in postoperative period has been decreased. Stroke incidence after cardiac surgery has been reduced to 1-8%, and delirium incidence to 7-10%, whereas the incidence of cognitive disorders remains 30-80% within one month after surgery, and 10-60% within three-to four months after surgery. However, a significant amount of controversial data is still present in publications on the issue (Goto, & Maekawa, 2014; Trubnikova, Mamontova, Syrova, Maleva, & Barbarash, 2014; Baba, Maekawa, Otomo, Tokunaga, & Oyoshi, 2014).

State of the problem

Despite a large number of studies carried out until this day, the main cause of postoperative cognitive dysfunction (POCD) has not been determined. In a series of recent prospective studies, it has been demonstrated that cognitive impairment after CABG is reversible in a significant part of patients and the majority of patients revert to the initial cognitive status within three to twelve months after surgery (Hassani, Alipour, Darvishi Khezri, Firouzian, Emami Zeydi, Gholipour Baradari, Ebrahim Zadeh, 2015). However, in 42% of patients cognitive impairment persists beyond 5 years after CABG. The aim of the research was to investigate incidence of cognitive impairment after CABG under the circumstances of artificial circulation in the early postoperative period (Evered, Silbert, Scott, Maruff, & Ames, 2016; Hogan, Shipolini, Brown, Hurley, & Cormack, 2013; Djaiani, Katznelson, Fedorko, Rao, Green, Carroll, & Karski, 2012).
Materials and methods

The research was carried out on the basis of the Federal State Budgetary Institution of Federal Cardiovascular Surgery Centre, Krasnoyarsk. A total of 146 patients with ischaemic heart disease (IHD) and scheduled for CABG were enrolled. Median age of the patients was 59.5 ± 7.1 [55.0; 65.0]. The operation was performed under the circumstances of AC. All the patients were examined for indices of the cognitive sphere one or two days prior to the surgery as well as eight to ten days after it. The following means of neurological assessment were used: the Frontal Assessment Battery (FAB), Mini Mental State Examination (MMSE), the Clock Drawing Test, assessment of mental capacity and mental processes tempo (Schulte Tables), direct and tardy reproduction of audio and visual material, associative thinking tests (semantic speech activity). The method of ten words memorising was applied in several steps: first – on the first presentation, second – total reproduction in five cycles, third – tardy reproduction. Emotional state of the patients was assessed by means of the Hospital Anxiety and Depression Scale (HADS). Additionally, the patients underwent their performance status examination, biochemical blood analysis, examination with the use of methods of functional diagnostics (echocardiogram, duplex scanning with colour Doppler imaging of brachiocephalic artery), neurological assessment, and neuropsychological testing.

Patients at the age under 70, scheduled for CABG, who signed informed consent, were included in the study. Exclusion criteria comprised the presence of chronic obstructive lung disease, chronic renal insufficiency, oncopathology, IHD associated with valvular heart disease, diabetes mellitus of any type, atrial fibrillation, steno-occlusive impairment of brachiocephalic arteries, or cerebral accident in anamnesis. Apart from this, preoperational scores of 24 or less on the MMSE scale and/or 11 on the FAB scale were also the reason for exclusion from the study.

All the patients underwent CABG in the conditions of AC. Anaesthesia and surgical protocols were standardised. After the operation all the patients were observed in the intensive care unit by means of ongoing ECG, haemodynamic and respiratory monitoring. The study was performed in compliance with the Declaration of Helsinki regulations. Every participant of the investigation signed the informed consent form and agreed that the study results would be used for scientific analysis.
Statistical processing of the obtained data was performed by means of nonparametric statistics via Statistica 6.0 software (Statsoft Russia). In the comparative analysis, the Wilcoxon criterion was used for testing the hypothesis of difference between two dependent samples, while the Mann-Whitney criterion was used for independent samples. For studying of the interrelation between quantitative features, non-parametrical Spearman's correlation analysis was used. Differences were considered significant at p≤0.05.

**Results and their discussion**

CABG led to clinical state improvement in all the patients, to their physical load tolerance increase and myocardial function improvement. All the patients were dismissed in satisfactory state of health 10-15 days after surgery. The initial evaluation of cognitive status of patients at the first stage was standardised by MMSE and FAB neuropsychological scales. Mean scores totalled 27.6 ± 1.47 and 16.3 ± 1.25 respectively, corresponding to mild cognitive impairment. Neuropsychological testing performed 8-10 days after surgery revealed signs of POCD. As it is apparent from the presented table, decline was observed in various cognitive domains and was registered on all the used cognitive function assessment scales.

Decrease in the general cognitive status index registered 8-10 days after CABG on the MMSE scale was statistically significant. Before the surgical intervention, the MMSE cognitive disorder level reached the score of 27.6±1.47, after surgery it was 26.8±1.49 (p=0.001). Evaluation of neuropsychological disorders on particular MMSE subscales was also performed. The “attention and calculation” and “memory” subscales results showed the most significant value decrease. The “attention and calculation” subscale score was 3.92±0.1 before CABG and 3.52±0.011 on days 8-10 after surgery (p=0.001); the “memory” subscale score was 2.02 ± 0.07 before the operation and 1.79± 0.07 on days 8-10 after the intervention (p=0.009).

Table 1.

<table>
<thead>
<tr>
<th>Neuropsychological test</th>
<th>Before surgery</th>
<th>Days 8-10 after surgery</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMSE</td>
<td>27.6 ± 1.47</td>
<td>26.8 ± 1.75</td>
<td>0.001</td>
</tr>
<tr>
<td>FAB</td>
<td>16.3 ± 1.25</td>
<td>15.5 ± 1.32</td>
<td>0.001</td>
</tr>
<tr>
<td>Clock drawing test</td>
<td>9.3 ± 0.8</td>
<td>8.78 ± 1.09</td>
<td>0.001</td>
</tr>
</tbody>
</table>
The overall FAB score was lower after the surgical treatment (see Table 1). Thus, subtests revealed the following deviations: impairment of dynamic organization of motor action in the “complex choice reaction time” test was reflected by scores of 2.85±0.03 before the surgery, 2.65±0.04 after the intervention (p=0.003); 2.86±0.03 points before the treatment, 2.66±0.04 after CABG in the “conceptualisation” test (p<0.001); in the “dynamic praxis”, scores of 2.18±0.07 before surgery, and 2.23±0.06 on days 8-10 after surgery were registered (p<0.001).

Amnestic disorders observed in patients on days 8-10 after the surgery were characterized by audio-verbal hypomnesia. According to the 10 words memorising test, patients had lower value of active reproduction of verbal material. By evaluation of audio-verbal memory, decrease of overall word number in five cycles was registered, as well as tardy reproduction productivity (see Table 1). During the postoperative period, patients tended to demonstrate lower selectivity during tardy reproduction as compared to direct reproduction during verbal material memorising.

During the visual memory examination (five short words memorising) in the postoperative period, statistically significant decrease of direct and tardy reproduction of visual material was registered (see Table 1). Furthermore, a significant decrease in the number of categorical associations was observed after operation. Decline in attention after the CABG was manifested in the increase of the Schulte test performance time (see Table 1).

To reveal interrelations in the data obtained, the Spearman’s correlation analysis was used. This analysis demonstrated that Clock Drawing Test result disimprovement was associated with increasing age (r=-0.45, p<0.05). No correlation was found between the test results and duration of AC.
Conclusion

POCD is the most common complication that may occur after direct myocardial revascularisation under the circumstances of AC. This fact is of special importance for patients of productive age, as development of POCD complicates the restoration process, reduces efficiency of rehabilitation actions and oftentimes the possibility of returning to labour practise itself. In this connection, the problem of POCD after direct myocardial revascularisation seems to be of great social medical importa.

However, at the present time, there are no generally accepted criteria for diagnosing POCD. The structure of POCD is vague. There are neither convincing data on its indices dynamics within a year nor uniform approaches to neurological testing and to evaluation of the cognitive impairment severity. Neuropsychological testing is known to be the most precise diagnostic method for POCD detection. This method includes tests that are capable to detect mild impairments in different cognitive spheres.

According to present knowledge, there is no generally accepted concept of POCD. This fact complicates elaboration of rehabilitation and follow-up strategies for patients with POCD. These issues require interdisciplinary investigation, further development of methods of diagnostics, prophylaxis and treatment of POCD in patients after CABG.

References


off-pump coronary bypass grafting surgery: comparative analysis of immediate and long-term results and of postoperative complications (heart rhythm disorder, cognitive and neurological impairments, rheological features and state of haemostatic system).

*Creative Cardiology*, (1), 28-50. (in Russian)
