

THE ROLE OF COGNITIVE FUNCTIONING IN THE SUCCESS OF SOCIAL REHABILITATION OF CARDIAC PATIENTS

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Abstract

The paper presents the results of an investigation of clinical characteristics and indicators of cognitive functioning (indicators of active attention and mental capacity, memory, verbal-logical and spatial thinking, as well as neuropsychological indicators of visual recognition of fragmented images), which are potentially significant for the resumption of work in the late postoperative period of patients with coronary heart disease (CHD), undergoing coronary artery bypass grafting (CABG). An attempt has been made to extract from the whole mass of the data obtained the most prognostically significant, which will allow to differentiate patients at the stage of preparation for CABG to those who will be able to continue working after the operation, and those who are more likely not able to return to work.

The present study enrolled 118 patients (of average age 59.71 ± 7.32 years) who underwent coronary artery bypass grafting with standard cardiopulmonary bypass technique. The examination using a neuropsychological test battery (including WAIS, TMT-test, Stroop test, TAS, Benton test, etc.) was performed in three stages: two days before CABG, 12-14 days and three months after the surgery.

Patients with CHD experience significant postoperative cognitive decline mostly in verbal memory and attention, while positive dynamics was observed in the visual and logical memory, as well as in spatial and verbal-logical thinking. Using factor analysis we identified 4 factors of cognitive functioning, which were called verbal memory, thinking, cognitive control and visual recognition. As a result of the study of indicators of cognitive functioning, which are potentially significant for the resumption of work in the late postoperative period, we constructed a model, according to which the accuracy of prediction of belonging to the "working" group and to the group of "nonworkers" in the remote postoperative period is 83.9% (the significance of the canonical function obtained is $p = 0.000066$). It was shown that the return to work in the long-term postoperative period is more typical for younger people who have lower indicators of the factors "Verbal memory" and "Thinking" before the operation and higher indicators of the factors "Verbal memory" and "Cognitive control" in the second and third stages of the study.

Keywords: *Cognitive functioning, coronary artery bypass grafting, coronary heart disease, rehabilitation, labor forecast.*

1. Introduction

Approximately 16.7 million people in the world die every year from cardiovascular diseases, including coronary heart disease (CHD). CHD is the leading disease in incidence and mortality in the general population (Leal, Luengo-Fernández, Gray, Petersen, & Rayner, 2006; World Health Statistics 2006). One of the most important treatments for coronary heart disease is myocardial revascularization. It is carried out with the use of either coronary artery bypass surgery (CABG) or transluminal coronary angioplasty balloon. However, coronary bypass surgery has been the most commonly performed surgical procedure for more than 30 years.

However, despite the increase in the volume of aid and an improvement of health of the majority of operated patients, working capacity of patients is frequently reduced. For example, several studies observed a significant improvement in physical health after CABG in 90% of patients, but only 40-60% (Pinna Pintor et al., 1992; McCrone, Lenz, Tarzian, & Perkins, 2001) of patients returned to their work without reducing the level of working capacity and preoperative qualification. Moreover, the level of social and professional functioning after cardiac surgery is largely determined by the emotional state, cognitive and personality characteristics of the patients, as well as by adherence to treatment during rehabilitation after cardiac surgery.

According to the results of our previous studies, 73.7% of patients did not have objective (according to the cardiologist) contraindications regarding returning to work three months after the surgery. Moreover, it turned out that patients themselves assess the state of their physical health significantly better three months after surgery than before surgery ($p < 0.05$) and in the early postoperative period ($p < 0.001$). However, only 8.8% of the patients successfully returned to work three months after CABG, and only 35.1% were planning to return to work soon.

Thus, the present research aims at an investigation of clinical characteristics and indicators of cognitive functioning (indicators of active attention and mental capacity, memory, verbal-logical and spatial thinking, as well as neuropsychological indicators of visual recognition of fragmented images), which are potentially significant for the resumption of work in the late postoperative period of patients with CHD, undergoing CABG, in order to develop a model, which will allow to differentiate patients at the stage of preparation for CABG to those who will be able to continue working after the operation, and those who are more likely not able to return to work.

2. Materials and methods

118 patients undergoing coronary artery bypass grafting with standard cardiopulmonary bypass technique in Federal Almazov Medical Research Centre (Saint-Petersburg, Russia) were studied. Cardiopulmonary bypass (CPB) is a technique that temporarily takes over the function of the heart. CPB is commonly used in heart surgery because of the difficulty of operating on the beating heart and it is well known to contribute to cognitive decline. The informed consent was obtained from all patients. Among them there were 58 (82.9%) men and 12 (17.1%) women; the average age of the patients was 59.71 ± 7.32 years. 48.6% of the patients were employed before the operation, 54.3% of patients were planning to return to their work after the operation. According to clinicians, the majority of the patients had no contradictions to come back to work three months after the surgery. But in fact, only 20.5% returned.

The examination was performed in three stages: two days before CABG, immediately before discharge from a hospital (12-14 days after CABG), and three months after CABG.

The methods used in the current study were selected with regard to the bio-psycho-social approach in modern clinical psychology and in accordance with the «Statement of Consensus on Assessment of Neurobehavioral Outcomes after Cardiac Surgery» (Zuyeva I.B. et al., 2011).

The study of cognitive functions of patients with CHD undergoing CABG was performed with the use of the following methods.

- (1) Verbal learning test «10 words» was used in studying short- and long-term verbal memory.
- (2) The method «Remembering stories» was used in studying logical memory.
- (3) «The Benton Visual Retention Test» was used in studying visual perception and visual memory.
- (4) The subtest «Similarities» of the Wechsler Adult Intelligent Scale (WAIS) was used in studying abstract verbal reasoning.
- (5) The «Simple analogy» method was used in studying verbal-logical thinking.
- (6) The subtest «Block Design» of the Wechsler Adult Intelligent Scale (WAIS) was used in studying spatial thinking.
- (7) The Trail Making Test (TMT Parts A and B) was used in studying psychomotor speed, attention switching and mental flexibility.
- (8) The Stroop Color-Word Test (SCWT) was used in studying two indicators: processing speed, as well as selective attention and resistance to cognitive interference.
- (9) Computer technique «Visual acuity» was used to measure visual acuity.
- (10) «Gollin Incomplete Figures Test» was used in studying the ability of visual recognition of the fragmented images.

3. Results

At the first stage of the research the whole set of studied psychometric and neuropsychological indicators of cognitive functioning was analysed using factor analysis. As a result, 4 factors of cognitive functioning, explaining 62% of the total dispersion of signs, were identified:

1. Thinking (this factor includes the following cognitive indicators: abstract verbal reasoning, verbal-logical thinking, spatial thinking, visual memory, logical memory);

2. Visual recognition (visual recognition of the fragmented images);
3. Verbal memory (short-term and long-term verbal memory);
4. Cognitive control (psychomotor speed, attention switching and mental flexibility, processing speed, selective attention and resistance to cognitive interference).

At the next stage of the research discriminant analysis was used in order to identify clinical characteristics and indicators of cognitive functioning, which are potentially significant for the success of social and labour rehabilitation of patients (resumption of work in the late postoperative period). Using results of the discriminant analysis, we develop a model, which allows to differentiate patients at the stage of preparation for CABG to those who will be able to continue working after the operation, and those who are more likely not able to return to work.

The constructed model allows to predict correctly belonging to the group of “workers” and to the group “non-working” on the basis of discriminant variables in 83.9% of cases (84.2% in the case of patients who returned to work, and 83.7% in the case of patients not returned to work).

The model includes such discriminant variables as age, the rate of compliance (measured by the Morisky-Green test), the number of heart attacks, the duration of illness, the number of hospitalizations in the past year, body mass index, the duration of the surgery, aortic cross-clamping and of the use of cardiopulmonary bypass during surgery, the number of diseased arteries, as well as 12 variables that reflect the level of cognitive functioning at different (three) stages of the investigation.

Table 1 presents the standardized coefficients of the canonical function, reflecting the most prognostically informative indicators regarding the division into groups of “working” and “non-working” and allowing to determine the ratio of contribution of each variable.

Table 1. Standardized coefficients of the canonical function for the most informative indicators.

Psychodiagnostic indicators	Coefficient value
Age	0,805001
Verbal memory (1th stage)	0,665799
Thinking (1th stage)	0,295777
Verbal memory (2th stage)	-0,575515
Cognitive control (2th stage)	-0,397905
Cognitive control (3th stage)	-0,532787
Dynamics of visual recognition	0,507482

According to the data presented in Table 1, the most significant contribution to the fact that the patient will be classified as “working” or “non-working” three months after CABG has the variable “age”: the older is the patient, the less likely he is to return to work after the operation. It also turned out that the higher were the indicators “Verbal memory” and “Thinking” before the operation, the less likely the patient is to continue his professional activity. This may be explained by the fact that the “Verbal memory” and “Thinking” factors were reduced in the preoperative period due to the underlying coronary disease, which indicates the possibility of a potential improvement of these factors after the surgery.

However, the higher were the indicators “Verbal memory” and “Cognitive control” at the second stage of the research and the higher was the indicator “Cognitive control” at the third stage of the research, the more likely patients are to return to work activity. In addition, the greater was the dynamics of “Visual recognition”, the less likely the patients continue to work after surgery.

It should be emphasized that clinical indicators were not included in the constructed model, which indicates the high significance of cognitive functioning indicators in the social-labor prognosis of patients with CHD, undergoing CABG. It is also important to note that since the Age variable is included in the canonical function described above, the phenomenon of age-related changes in cognitive functions can be excluded from consideration.

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