

Anxiety and its role for cognitive changes in patients after coronary artery bypass grafting

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Summary

Aim of the study: Several psychosocial characteristics are well known to be importantly related to coronary heart disease (CHD). However, psychological aspects of surgical treatment of CHD and its implications for rehabilitation perspectives and cognitive changes of cardiac patients remain poorly understood. The article presents the results of studying the dynamics of emotional state of patients after coronary artery bypass grafting (CABG), measured before the surgery and at different stages of the rehabilitation process, and on a comparative analysis of trait and state anxiety and alexithymia of patients with CHD with different cognitive dynamics.

Subject or material and methods: 118 patients with CHD, undergoing CABG were examined (average age $59,86 \pm 7,31$ years). The study was conducted using the clinical and psychological method and a specially developed complex of psycho – and neuropsychological methods for assessing various spheres of cognitive functioning and emotional state of the patients.

Results: It was shown that patients with cognitive impairment are characterized by great anxiety in the field of social contacts and an understanding of the social sphere as the main source of anxiety stress and uncertainty in itself. Patients complaining about the state of the cognitive sphere generally have a greater degree of personal anxiety, a feeling of emotional discomfort, dissatisfaction with life situations, and increased anxiety in the field of social contacts.

Discussion Most differences in the emotional state of patients with different cognitive dynamics were found even before surgery.

Conclusions: Therefore, it seems reasonable to introduce additional short-term psychotherapeutic interventions aimed at stabilizing the emotional state of patients preparing for CABG surgery.

anxiety, rehabilitation, cognitive function, emotional state, coronary surgery

INTRODUCTION

Cardiovascular diseases, including coronary heart disease (CHD), remain the most common cause of death in the world. CHD is leading in the incidence and mortality in the general pop-

ulation [1,2]. Along with the use of conservative treatment of CHD, the role of surgical intervention in treatment CHD has been growing recently. One of the most important surgical treatments of coronary heart disease is coronary artery bypass surgery (CABG). The need for this intervention reaches 550-600 operations per 100,000 people [3].

However, despite the increase in the volume of aid and an improvement of health of the ma-

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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% [4,5] 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.

A lot of recent studies have shown the need to study cognitive functions and their dynamics in patients with coronary artery disease who underwent CABG surgery [6]. The high prevalence of cognitive impairments accompanying myocardial revascularization determines relevant trends in studying this issue. First, it seems to be useful to predict the development of cognitive disorders in order to optimize the subsequent treatment [7], because a dynamic monitoring and an adequate treatment can lead to an improvement in 20-40% of patients with vascular cognitive impairments [8,9]. Second, an increased attention should be paid to the early diagnosis of changes in the intellectual activity under the influence of the disease and vascular cognitive impairments, identifying their specific differences from age-related changes of cognitive functions. Third, the development of interventions aimed at prevention of postoperative cognitive impairment may reduce the appearance of ischemic strokes in the perioperative period [10] and neurodegenerative diseases in the late postoperative period [11]. Moreover, it seems to be relevant to define the risk factors determining the presence of cognitive pathology, accompanying cardiac surgery.

The majority of risk factors are related to clinical characteristics of patients with coronary artery disease. At the same time, the study of psychological correlations of both beneficial and detrimental cognitive changes after CABG seems to be relevant. An increased attention is traditionally paid to the characteristics of the emotional state, in particular anxiety, of patients before and after surgery. Such situational factors as waiting for surgery, doubts about the possibility of a successful outcome, ideas about progres-

sion of the disease with the possible development of recurrent myocardial infarction increase the level of anxiety. Moreover, such personality trait as alexithymia is well known to contribute to the emergence and course of psychosomatic diseases. Recent studies have shown that psychosocial factors, such as stress, anxiety, depression, social isolation contribute significantly to the pathogenesis and expression of coronary artery disease [16].

Until recently, the data on the association of anxiety and coronary heart disease in most cases was limited to demonstrating increased mortality rates among psychiatric patients with anxiety disorders [17]. However, a recent meta-analysis showed a 16 percent prevalence of anxiety disorders in patients with cardiovascular disease, with generalized anxiety disorder having the worst prognosis for CVD among anxiety disorders [18].

It has been shown that patients with anxiety disorders are more prone to an unhealthy lifestyle. The hyperreactivity of the hypothalamic-pituitary system, which leads to an increase in blood pressure, an increase in heart rate, a decrease in heart rate variability, a spasm of the coronary arteries, progression of atherosclerosis, and also an increase in damage to endothelial cells, is considered as another pathophysiological mechanism of the effect of anxiety and depression on the patient's body [19].

Despite the fact that a large number of studies have been carried out on the specifics of anxiety symptoms in patients with CHD, there is practically no data on relationship between the severity of personal and situational anxiety and the level of cognitive functioning.

One of the few works in this area is devoted to the study of personal anxiety as a risk factor for cognitive impairment in patients undergoing direct myocardial revascularization [20]. According to the data obtained, both before and after CABG in the group of highly anxious patients, compared with moderately anxious patients, the worst neurophysiological indicators were observed. It can be assumed that one of the reasons for the suppression of cognitive functions in patients with coronary heart disease in the postoperative period may be a high level of personal anxiety.

The research, presented in the paper, is a part of a complex dynamic study of the cognitive

dysfunction in patients with CHD, its relationship to emotional characteristics and personality, adherence to treatment, clinical indicators of the patient's condition and the characteristics of the surgery performed, as well as the relationship between the complex of psychological and clinical characteristics, and the effectiveness of postoperative rehabilitation, including social and labor recovery of patients. The research project was developed in connection with the urgent request for the creation of a complex system of psychological rehabilitation for patients undergoing treatment in Federal Almazov Medical Research Centre. Cardiac surgeons and cardiologists took part in the creation of the research program and its implementation. The current part of the research project aims at studying the dynamics of emotional state of patients after CABG (measured before the surgery and at different stages of the rehabilitation process) and on a comparative analysis of trait and state anxiety and alexithymia of patients with CHD with different cognitive dynamics.

MATERIALS AND METHODS

This study involved patients undergoing treatment in the rehabilitation unit of Federal Almazov Medical Research Centre (Saint-Petersburg, Russia). The examination was performed in three stages: two days before CABG, immediately before discharge (12-14 days after CABG), and three months after CABG. The informed consent was obtained from all patients. Patients who underwent emergency surgery and patients with serious neurological or mental disorders were not included in the study.

118 patients undergoing coronary artery bypass grafting with standard cardiopulmonary bypass technique were studied. Among them there were 95 (80,5%) men and 23 (19,5%) women; the average age of the patients was $59,86 \pm 7,31$ years.

Analysis of the socio-demographic characteristics showed that among the examined patients, persons with secondary (38,1%) and higher (31,4%) education prevail. The majority of patients (55,9%) identified their professional activities as associated with physical labor. The study of the characteristics of marital status revealed

the prevalence of patients in the first marriage (57,6%), were divorced at the time of the survey, 15,3% of patients were remarried or widowed (11,9%), 3,4% of surveyed individuals were never married. At the time of the initial examination (before surgery), 56 (47,5%) patients were employed, 68 (57,6%) patients planned to return to work after rehabilitation treatment. 13,7% of patients had group III disability, 11,1% and 0,9% had group II and I, respectively, and 74,4% of the patients had no disability.

Analysis of the biomedical characteristics showed that the average duration of CHD since diagnosis was $5,42 \pm 4,82$ years. The majority of patients (66,7%) in the period of preparation for CABG suffered from angina pectoris of functional class III, 23,4% of patients – functional class II. The vast majority of patients (94,9%) suffered from stage III hypertension (risk 4); in 74,6% of patients in the anamnesis at least one myocardial infarction was recorded. Only 12,7% of patients had less than three affected vessels that were subject to revascularization, the average number of affected arteries was $3,34 \pm 1,06$. In 92,7% of cases, the CABG operation was performed as planned. The average duration of the operation was $M = 215,32 \pm 56,01$ minutes; time of extracorporeal membrane oxygenation – $M = 99,04 \pm 36,70$ minutes; aortic clamping time – $M = 58,97 \pm 32,34$ minutes.

The methods for the study were selected with regard to the bio-psycho-social approach in modern clinical psychology and in accordance with the research purposes and the statement of consensus on assessment of neurobehavioral outcomes after cardiac surgery [12].

For studying cognitive functions (the main characteristics of active attention, rate of psychomotor reactions, mental capacity, mnemonic activity, verbal-logical and spatial thinking) of patients with CHD undergoing CABG the following methods were used: «The Trail-Making test (TMT-test)»; the subtests «Similarities» and «Block Design» from the Wechsler Adult Intelligent Scale (WAIS); pathopsychological samples «10 words», «Remembering stories», «Simple analogy»; «The Benton Visual Retention Test»; «The Stroop Color-Word Test»; computer techniques «Visual acuity» and «Gollin Incomplete Figures Test».

The emotional state of patients in the perioperative period and its dynamics in the rehabili-

tation process were studied using «The Integrative Anxiety Test (ITT)». In order to investigate the level of alexithymia, we used «The Toronto Alexithymia Scale (TAS)». The learning effect was minimized by using parallel forms of the tests wherever possible.

Statistical analysis of study results. The results obtained were processed with the use of the standard statistical techniques included in SPSS 19 and Statistica. We used Wilcoxon signed rank tests for a comparative analysis of the preoperative and postoperative variables of cognitive functioning. The scores obtained versus normative scores were analyzed by using t-tests. Differences were considered significant at $p < 0.05$.

RESULTS

The data reflecting the general level and intensity of various components of state and trait anxiety of patients with CHD undergoing surgery were obtained by using «The Integrative Anxiety Test» (ITT). Table 1 shows the results of a comparative study of the intensity of trait anxiety, measured during the preparation for CABG, and the indicators of state anxiety, measured before the operation, 12-14 days before it, and three months after the operation.

Table 1. Indicators of the trait and state anxiety of patients undergoing CABG

| Indicators of anxiety components | Trait anxiety | State anxiety on the first stage (before CABG) A | State anxiety on the second stage (12-14 days after CABG) B | State anxiety on the third stage (three months after CABG) C | Significant differences |
|----------------------------------|---------------|---|--|---|-------------------------|
| | M ± m | M ± m | M ± m | M ± m | |
| General indicator | 4,40 ± 1,88 | 3,63 ± 2,12 | 3,19 ± 1,99 | 3,97 ± 2,13 | AB** BC** |
| Emotional discomfort | 5,31 ± 2,06 | 2,35 ± 2,41 | 2,47 ± 1,96 | 4,00 ± 2,19 | AB*** BC*** |
| Asthenic component | 5,29 ± 2,11 | 4,26 ± 2,35 | 5,68 ± 2,42 | 4,92 ± 2,48 | AB*** |
| Phobic component | 2,97 ± 2,10 | 3,72 ± 2,29 | 2,64 ± 2,17 | 4,92 ± 2,48 | AB*** BC** |
| Anxious assessment of the future | 4,81 ± 2,31 | 4,73 ± 2,57 | 3,47 ± 2,42 | 5,05 ± 2,22 | AB*** BC*** |
| Social defensive reactions | 3,02 ± 2,45 | 3,47 ± 2,65 | 3,31 ± 2,53 | 3,27 ± 2,59 | |

Remark 1. In the ITT method the average anxiety level is 4-6 points. The high level of anxiety (7 points and above) corresponds to general psychological discomfort and disharmony with the environment (Bizyuk A.P. et al., 2005).

Remark 2. The notations ** and *** correspond to the statistical significance of $p < .05$ and $p < .01$ respectively.

According to the data given in Table 1, most of the indicators of state and trait anxiety correspond to a low level of intensity. An analysis of the trait anxiety leads to the conclusion that the highest intensity of anxiety, which actually corresponds to the average level, was observed for the following indicators: «Emotional discomfort», «Asthenic component», «Anxious assessment of the future». The data show that, the dissatisfaction with a certain life situation (possibly, caused by the current illness) decreases. The results obtained also signify that patients preparing for the surgery demonstrate the following characteristics: fatigue, moderately ex-

pressed fears projection on the time perspective, general concern for the future based on an increased emotional sensitivity, and, frequently, lack of confidence in the positive outcome of the treatment.

A comparative analysis of the state anxiety in the course of all three stages of the study show that three months after the surgery the general indicator was statistically significantly higher than 12-14 days after it. The intensity of the «Asthenic component» of state anxiety before the surgery is statistically significantly lower than 12-14 days after it, which is mainly caused by the severity of the intervention and general physical

discomfort. A statistically significant decrease in the intensity of state anxiety after the surgery (from the first stage to the second) is detected for the following indicators: «Emotional discomfort», «Asthenic component», «Anxious assessment of the future». However, the same indicators demonstrate a statistically significant increase in the level of anxiety after discharge from a hospital.

In accordance with the purposes of the research, the level of alexithymia was measured by using «The Toronto Alexithymia Scale» (TAS) during the preparation for myocardial revascularization. We treat alexithymia as a complex of cognitive and affective personality traits, which can influence the development and course of psychosomatic diseases. The average indicator of alexithymia for all patients examined is equal to 71.94 points (64 points and less indicate the absence of alexithymia; 72 points and more indicate the presence of alexithymia). The absence of alexithymia is demonstrated by only 26.3% of patients; 42.1% of patients demonstrate the presence of alexithymia, whereas about 31.6% of patients nothing definite can be said. This fact indicates that 42.1% of patients undergoing CABG have difficulties in the defining (identifying) and describing their own feelings and in distinguishing feelings from body sensations. Also the latter patients have a reduced ability for symbolization (this reduction is evidenced by the poverty of imagination) and are more focused on external

events than internal experiences. Such personality characteristics can lead to an amplification of physiological responses to stress, to a fixation on a somatic component of emotional excitement, and to further formation of hypochondriacal positions and psychosomatic disorders.

The mathematical expression of the dynamics of cognitive functions was carried out using the definition of cognitive impairment used in foreign studies, and approved in our previous studies [21].

The mathematical definition of cognitive impairment after CABG was based on the standard deviation (SD): in case of detection of a postoperative decrease three months after CABG in the psychodiagnostic indicator by at least 1 SD (standard deviation for the entire group) in at least two tests, it can be concluded that there is a cognitive deficit in this patient. According to this criterion, cognitive impairment three months after surgery was detected in 33.3% of patients.

The results of a comparative study of the emotional state of patients, divided into groups according to the presence of an objectively detectable cognitive impairment during rehabilitation and based on a subjective assessment of the state of cognitive functions, are presented in tables 2 and 3, respectively. The tables show only those characteristics of the emotional state for which statistically significant differences were obtained.

Table 2. Comparative analysis of the characteristics of the emotional state of patients without deterioration and with a deterioration in cognitive functioning after CABG

| Characteristics of the emotional state | Patients without cognitive impairment (M±SD) | Patients with cognitive impairment (M±SD) | Significance level |
|--|--|---|--------------------|
| Alexithymia | 65,08±10,29 | 73,23±11,85 | p<0,05 |
| Personal anxiety | | | |
| Social defensive reactions | 2,63±2,43 | 4,31±2,67 | p<0,001 |
| State anxiety in the preoperative period | | | |
| Social defensive reactions | 2,47±2,18 | 5,25±2,91 | p<0,05 |

As shown in Table 2, patients who did not have cognitive impairment in the late postoperative period, according to the TAS results, fell into the zone of uncertain values, while patients with cognitive impairment revealed the presence of alexithymic personality traits. Also, patients with cognitive impairment are characterized by

a greater degree of severity of the component “Social defensive reactions” both in the structure of personal and situational anxiety, which means greater anxiety in the field of social contacts and an understanding of the social sphere as the main source of anxiety tensions and self-doubt.

Table 3. Comparative analysis of the emotional state characteristics of patients with and without subjective complaints of cognitive functioning

| Characteristics of the emotional state | Patients who did not complain (M±SD) | Patients who complained (M±SD) | Significance level |
|---|--------------------------------------|--------------------------------|--------------------|
| Trait anxiety | | | |
| General indicator | 4,00±1,77 | 4,73±1,92 | p<0,05 |
| Emotional discomfort | 4,85±2,06 | 5,69±2,00 | p<0,05 |
| Social defensive reactions | 2,52±2,47 | 3,47±2,54 | p<0,05 |
| State anxiety in the early postoperative period | | | |
| Social defensive reactions | 2,66±2,41 | 3,83±2,64 | p<0,05 |

The data presented in table 3 indicate that patients who complained about the level of their cognitive functioning even before surgery differ from patients who have not presented such complaints in terms of the severity of the following components in the structure of personal anxiety: general indicator, "Emotional discomfort", "Social defensive reactions", as well as the indicator "Social defensive reactions" in the structure of situational anxiety in the early postoperative period. Patients with complaints generally have a greater degree of personal anxiety, a feeling of emotional discomfort, dissatisfaction with the life situation, and increased anxiety in the field of social contacts.

Thus, the analysis of the characteristics of the emotional state of patients with different dynamics of cognitive functions during rehabilitation after CABG showed that patients with worse dynamics often have pronounced alexithymic features in their personality structure; they are characterized by greater anxiety in the field of social contacts, which leads to greater exposure to stress (due to greater conflict and a tendency to assess neutral situations as threatening) and a reduced level of social support, which makes it difficult to access social resources. Since the majority of differences in the emotional state of patients with different cognitive dynamics were detected before surgery, it seems reasonable to introduce additional short-term psychotherapeutic measures aimed at stabilizing the emotional state of patients preparing for CABG surgery.

DISCUSSION

The present research has demonstrated significant changes in the emotional state of the pa-

tients, undergoing CABG. The work has also discovered a significant connection between characteristics of the emotional state and the dynamics of cognitive functions during the recovery process.

In agreement with the vast majority of previous studies [13,14] we found that the indicators of state anxiety reach a very high level directly before surgery and decreases significantly within 12-14 days after surgery. Such a dynamic is probably related to the fact that patients have successfully already undergone the surgery, and fears of anesthesia and even death, typical for the situation of surgical intervention, have not materialized. However, almost all the indicators of state anxiety are higher three months after CABG, than 12-14 days after it. Presumably, this effect is related to the fact that under the constant supervision in a hospital the patients are less likely to experience anxiety, particularly for their health. More over, this trend can probably be explained by patients' unadjustment for living outside a hospital and fears for their lives and health status, which can appear without medical supervision.

The results of studying the correlation between cognitive functioning and the level of trait and state anxiety in contrast with some previous studies [13] showed that the changes of cognitive functioning are statistically significantly correlated with the indicators of emotional state of the patients. Anxiety can be considered as a factor explaining the decrease in the level of cognitive functioning in patients before the operation [15]. In particular, we found that the dynamics of cognitive functions is closely related to the indicator of «Social defensive reactions» in the structure of trait anxiety. This means that the dynamics is the worse the more patients are like-

ly to experience anxiety in social contacts and to consider their social sector as a major source of stress and self-doubt.

A comparative analysis of the characteristics of the emotional state of patients with different dynamics of cognitive functions during cardiac rehabilitation after CABG showed that patients with worse cognitive dynamics often have pronounced alexithymic features in their personality structure, and they are also more anxious in the field of social contacts, which leads to greater exposure stress and lower levels of social support, makes it difficult to access social resources. At the same time, patients who complained generally have a greater degree of personal anxiety, a feeling of emotional discomfort, dissatisfaction with their life situation, and increased anxiety in the field of social contacts.

CONCLUSIONS

The presented results have a significant impact on optimizing the rehabilitation process and increasing its effectiveness in patients undergoing CABG and other cardiac operations. The results obtained indicate the need for psychological support for patients in the postoperative period in the form of an additional psychotherapeutic and socio-rehabilitation interventions during the outpatient rehabilitation period aimed at correcting the revealed changes in the emotional state of patients and optimizing their quality of life. The importance of taking into account the peri- and postoperative cognitive changes in patients with coronary artery disease is obvious in order to prevent long-term neurocognitive deficits and restore the preoperative level of efficiency and quality of life in patients undergoing heart surgery.

Based on the results of the study, the following practical recommendations can be formulated.

- 1) It seems relevant to develop and implement psychotherapeutic interventions aimed at correcting the emotional state of patients. Since disturbances in the emotional state of patients were detected even before surgery, it seems reasonable to introduce short-term interventions aimed at stabilizing the emotional state of patients preparing for CABG surgery. This recommendation can be im-
- 2) Psychological support of patients in the late postoperative period (for example, in the form of thematic meetings or group psychotherapeutic work) also seems to be an extremely significant area of psychological rehabilitation after CABG. The main targets of such work can be patient confidence in their own capabilities, the search for additional resources, a positive assessment of prospects, motivation to further improve the quality of life through changing habits and lifestyle, as well as preventing the occurrence of such psychological consequences of open heart surgery as the patient's perception of himself as seriously ill patient, disabled as a result of CABG.
- 3) Training of cognitive functions. Timely detection and correction of cognitive impairments should occupy a special place in the system of rehabilitation measures after myocardial revascularization.
- 4) Educational programs and schools for patients. The main goals of such programs can be the formation of adequate attitudes in patients, increased motivation to participate in rehabilitation activities and secondary prevention of coronary artery disease. The main method of the "School" can be a group discussion devoted to the most relevant issues for this category of patients (the mode of physical activity, diet, psychological problems, restoration of marriage relations, the timing and possibilities of returning to work).

The following steps of the comprehensive study suggest the ascertainment of the relationship of the characteristics of patients' cognitive functioning after bypass surgery with the efficiency of cardiorehabilitation, medical and social prognosis of patients.

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