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Dynamics of cognitive functions in patients with hemoblastosis treated with hematopoietic stem cell transplantation[1]

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Abstract

Introduction. *The number of bone marrow transplantations is increasing worldwide. However, the issue of cognitive impairments following this procedure in hematologic malignancies remains poorly investigated.*

Aim. *The aim of this study was to investigate the level and dynamics of memory and attention parameters in oncological patients undergoing hematopoietic stem cell transplantation.*

Material and methods. *The study was conducted in three stages: pre-operation and two post-operation stages, on days 21 and 60, with control points corresponding to medical protocol milestones. The study involved 43 patients aged 18 to 62, including 22 males and 21 females.*

Results. *The study revealed that most memory-related parameters were at low levels, which may be attributed to pre-operative chemotherapy, and further decreased cognitive functions throughout the study (p=0.014, p=0.082, statistically significant in both cases). Attention assessment results indicated predominantly normal levels, while attention-switching parameters decreased from the second to the third stage of the study*

(p=0.33). The affective sphere before bone marrow transplantation was characterized by depressive symptoms at the sub-depressive level and upper bounds of situational anxiety. By the third stage of the study, these variables gradually decreased to normal values (p=0.03, p=0.07).

Conclusions. *In the context of this study, a decline in cognitive functions, including mediated, short-term, long-term, and mechanical memory, was observed. A similar trend was noted in attention concentration and attention-switching capabilities.*

Keywords: oncopsychology, clinical psychology, hematopoietic stem cell transplantation, cognitive functions, hemoblastoses, cognitive rehabilitation

Conflict of interest. The authors declare no conflict of interest

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BMT, bone marrow transplantation
CF, cognitive function
HE, higher education
IHE, incomplete higher education
LP, logical memory
MP, mechanical memory
SG, secondary general education
SS, secondary special
TMT, Trail Making Test = методика последовательных соединений

Introduction

Hemoblastoses are a group of diseases characterized by malignant neoplasms of the hematopoietic and lymphatic systems. Speaking about somatic illness, it is impossible to ignore the psychological characteristics of patients [1].

Currently, oncological diseases are treated with aggressive, toxic methods that have a significant impact on the entire human body: chemotherapy is not a specific treatment, it affects the human body as a whole. In particular, a wide range of cognitive function (CF) impairments is associated with this.

The problem of investigating CFs is becoming increasingly relevant with the spread and high efficiency of bone marrow transplantation (BMT). At the preparatory stage to the operation, the patient undergoes high-dose intensive chemotherapy.

Several factors influencing patient's CFs can be identified: the consequences of chemotherapy and radiation therapy, of the BMT preparatory stage, various postoperative complications, and patient's emotional state [2].

Only a small number of studies aimed at investigating the dynamics of CFs in BMT are presented in the Russian and foreign literature. Among the most interesting studies in the context of this study there is the work aimed at assessing the efficacy of non-pharmacological methods to prevent impairments of cognitive functions after BMT [2].

This paper examines the dynamics of patients' cognitive functions and their relation to the emotional state within 2 months after BMT, as well as the impact of implementing individual recommendations on the listed parameters. The data obtained must be taken into account when developing psychological support programs for hematological oncology patients and their subsequent rehabilitation.

Aim. To identify the severity of various cognitive impairments and their relationship with the emotional state of patients with hematologic malignancies who have undergone hematopoietic stem cell transplantation.

Study objectives:

1. Study the levels of logical, mechanical, operational, mediated, short-term and long-term memory types and assess the impairment severity, as well as the dynamics of memory state in patients with hematological malignancies.

2. Identify the level of concentration and attention-switching capability to assess the impairment severity and dynamics of these attention characteristics in hematological oncology patients.

3. Investigate the level and dynamics of spatial orientation and attention span in this group.

4. Assess the levels of depressive symptoms, situational anxiety, and personal anxiety and determine the dynamics of these severities in patients with hematological malignancies.

5. Establish the relationship between the parameters of memory, attention, and the emotional state of patients.

Material and methods

A classic longitudinal study was conducted at the Clinic of the Research Institute for Pediatric Oncology, Hematology, and Transplantology named after R.M. Gorbacheva of the Pavlov First Saint Petersburg State Medical University, in the Department for Bone Marrow Transplantation, the Day Hospital, and the Department of Rehabilitation Medicine from September 2018 to March 2020.

In accordance with the objectives set in the study, experimental psychology and clinical psychology methods were used:

1. A clinical interview aimed at studying the socio-demographic characteristics of study participants, self-assessments of cognitive functions and collecting a psychological history [1, 3].

2. A.R. Luria "Pictogram" test, which is a variant of mediated memorization [4].

3. The methodology “Study of logical and mechanical memory” aimed at studying logical and mechanical memory by memorizing two rows of words [5].

4. A.R. Luria methodology “Memorizing 10 words”, which allows studying the level of short-term and long-term memory [6].

5. TMT (Trail Making Test) – test for visual-motor coordination – Connection Sequence Method (TMT, Trailmaking test) [7, 8]. Part A assesses attention, spatial orientation and motor coordination, reflecting the characteristics of the mental activity tempo, part B assesses executive functions, attention-switching, and working memory [9].

6. Test-questionnaire Beck Depression Inventory was proposed by Aaron T. Beck in 1961 and allows the identification of the symptom list and the depression severity [10].

7. The anxiety test by Ch.D. Spielberg and Y.L. Khanin, which makes it possible to differentiate anxiety both as a personal characteristic and as a mental state [5].

Patients with an established diagnosis of hematological malignancies aged 18 to 62 years were invited to participate in the study. The selection criteria are presented in Table 1.

Table 1. Selection criteria for study participants

Inclusion criteria	Exclusion criteria
Established diagnosis of hemoblastosis group	Psychiatric diseases
Age from 18 to 62 years	Skipping the second stage of the study
Upcoming BMT at the time of study entry	Concomitant diseases: significant decrease in vision or hearing, etc.
Possibility of undergoing a health examination at the time of meeting with the patient	–

The study included 43 patients: 22 (51%) men and 21 (49%) women. The age of the participants varied from 18 to 62 years old. The mean age was 36.5 years.

In the presented sample size, 7 patients (16.3%) had general secondary (GS) education, 7 (16.3%) had specialized secondary (SS) education, 26 (60.5%) had higher education (HE) and 3 (7%) had incomplete higher education (IHE).

Potential participants were informed of following all ethical principles in the study, the purpose of the study, as well as of its duration and the possibility of receiving feedback on the test results. Immediately before the study, the patient was asked to sign a voluntary informed consent.

The study was conducted in three stages, which coincided with generally accepted timepoints of medical clinical monitoring of a patient undergoing BMT.

Stage 1. The first visit took place before the patient underwent BMT.

Based on the results of each visit, patients received feedback from a specialist, including recommendations for training those cognitive functions that were below the level of reference values. At the second and third stages of the study, patients reported compliance or non-compliance with the recommendations received (during a verbal survey), which was recorded in the protocol for further analysis.

Stage 2. The second visit took place, as a rule, on the 21st day (with possible time deviation of 3 days) after the transfusion of donor blood components, which was reasoned, first of all, by the need to consider the patient somatic condition.

Stage 3. The final stage of the study took place 60 days after the patient underwent BMT or 3 days earlier or later than this date, depending on the external circumstances and capabilities of the patient.

Among the recommendations that patients received were both

general (adherence to diet, timely rest, etc.) and those aimed at training some CFs if their parameters were below the average statistical norm. Since such recommendations should be easy to follow, intuitively clear, and not require a lot of time, so in order to train their memory, patients were asked to memorize a four-line verse or more a day, draw up a plot outline for the film they just watched, memorize objects on the table, retell the articles, books, etc they had read to those around them; to train attention, it was recommended to find differences in pictures, solve sudoku, concentrate and look at a specific object for 1 minute, etc.

Primary processing of patient responses and the results of training was performed in the WPS Spreadsheets software; further statistical analysis of the data was made using the SPSS Statistics program.

A comparative analysis of three dependent samples was made using the Wilcoxon T-test; the correlation analysis to search for relationships between parameters was made using the Spearman correlation test.

Results

Results of a comparative analysis of memory characteristics. In this study, a comparative analysis of indirect, short-term and long-term memory parameters was carried out. No statistically significant differences were found between the parameters of mediated memory at all stages. However, there is a tendency towards a decrease in the described parameter from the first stage to the second ($p=0.082$).

Fig. 1 demonstrating the group average results of patients show a tendency towards a decrease in the number of reproduced stimuli from the first to the second stage of the study, as well as an increase in the number of reproduced stimuli from the second to the third stage.

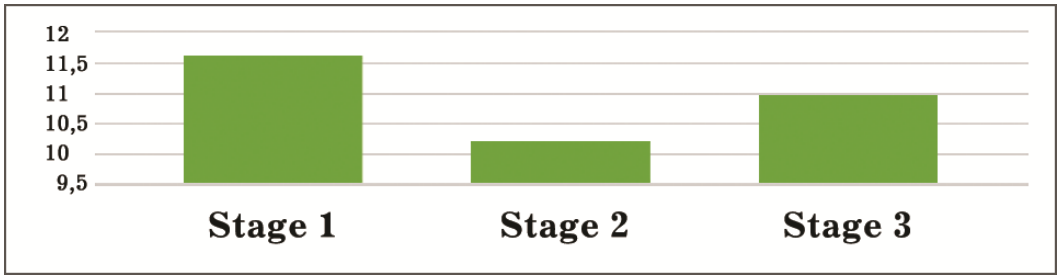

Fig. 1. Average results of mediated memory testing (in number of stimuli)

No statistically significant differences were found between the short-term and long-term memory parameters of patients at different stages of the study.

When applying the “10 words” technique, the stimulus material and its reproduction by the patient were performed 5 times; the mean value of these measurements was taken as an indicator of short-term memory. Fig. 2 shows the mean values of applying the “10 words” technique at different stages of treatment. A tendency was found towards a decrease in the level of short-term and long-term memory, which was more pronounced when comparing the results between the first and second stages of the study and significantly less pronounced when comparing the results between the second and third stages.

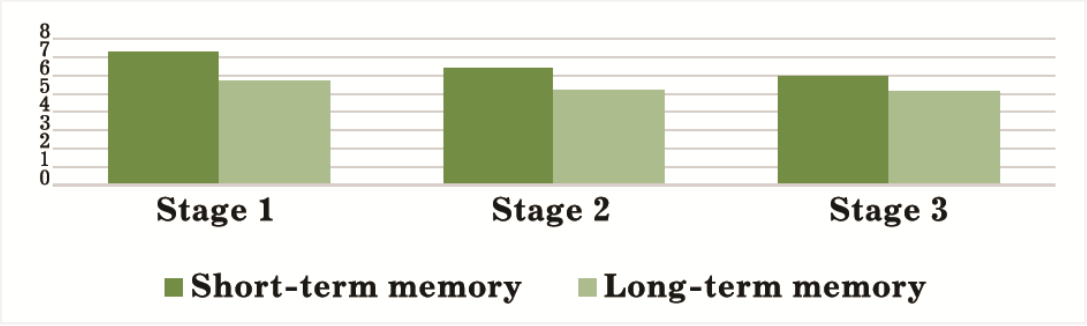

Fig. 2. Average results of short- and long-term memory testing (in number of words)

The average assessments of logical memory (LM) and mechanical memory (MP) were at the lower limit of the norm throughout the study: 8.48 was the average assessment of LP, the norm corresponding to 8 words, 3.58 was the average assessment of MP, the norm being equal to 3 words.

Mechanical memory in patients undergoing hematopoietic stem cell transplantation for hematologic malignancies decreased 60 days after surgery compared to the results on the 21st day after the transplantation ($p=0.014$, statistically significant), as well as at the trend level – after 21 days compared to the results before BMT ($p=0.085$).

The results of a comparative analysis of such attention characteristics as concentration, memory-switching, spatial orientation and attention span are presented by descriptive statistics data of the sequential connection technique, mean values are expressed as scores (Table 2). At the same time, the individual results of the majority of patients, as well as the average values indicated in the Table, were within the reference range (scored 5–7).

Table 2. Descriptive statistics of the Trail Making Test results

	Average value		Standard deviation	
	Form A	Form B	Form A	Form B
Stage 1	7.47	6.38	±2.87	±3.75
Stage 2	7.25	6.37	±2.41	±2.76
Stage 3	6.68	5.9	±2.26	±2.12

A comparative analysis of attention-switching assessments indicates statistically significant differences: at the third stage, patients showed lower results compared to those at the second one ($p=0.033$).

Results of a comparative analysis of emotional state assessments:

the mean values of personal anxiety were at the upper limit of moderate anxiety (42.1) before hematopoietic stem cell transplantation, while the mean values were in the middle of the moderate values (38.2) range on the 21st day after surgery, and at the lower limit (32.4) on the 60th day; The values of personal anxiety also corresponded to the range of moderate, mean values.

The results of the statistical analysis indicated a decrease in the level of anxiety on the 21st day after transplantation compared to the level of anxiety before surgery (p=0.004, statistically significant), which was presumably associated with a decrease in general emotional stress after the transfusion, which was also confirmed by the results of a study of depressive symptoms.

The situational anxiety values decreased from the 21st day after BMT to the 60th day at the level of a statistical trend (p=0.075).

When analyzing the parameters of personal anxiety before hematopoietic stem cell transplantation and on the 60th day, a statistically significant difference was found: personal anxiety became lower (p=0.049), which can be interpreted as the patients' tending to rely on the current emotional state when assessing the general background.

The average values of the results of studying the emotional sphere of patients before BMT and on the 21st day after it corresponded to the assessments of a subdepressive state (15.4); on the 60th day after surgery, the severity of depressive symptoms was within normal range of values (5.9).

In men, the severity of depressive symptoms on the 60th day after BMT relatively to the 21st day decreased statistically significantly faster compared to women (p=0.031).

The results of the comparative analysis reflect a statistically significant, sustainable decrease in the severity of depressive symptoms

(p=0.024, p=0.036, p=0.014), which may be directly associated with the hematopoietic stem cell transplantation operation. However, we cannot exclude the fact that patients who developed moderate or severe complications, and who, presumably, could secondarily have developed depressive states against this background, did not take part in the study due to poor health.

Results of correlation analysis: as can be seen from Table 3, a direct relationship was revealed between the improvement of some memory assessments at the third stage of the study and the recommendations given based on the study second stage results: better results were found in patients who followed those recommendations.

Table 3. Significance level of correlation analysis

On the 60th day after bone marrow transplantation	Types of memory			
	mediated	operative	long-term	logical
Significance level (p)	0.078	0.023	0.081	0.30

A relationship was also found between compliance with recommendations and situational anxiety: patients who completed the training exercises showed lower anxiety during the third visit (p=0.036).

The correlation analysis indicated the mutual influence of the emotional state components of patients: a direct relationship was found between the severity assessments of depressive symptoms (E. Beck Depression Inventory) and the severity of situational anxiety (Spielberg-Khanin Anxiety Test). Thus, the higher was the level of situational anxiety, the higher the severity of depressive symptoms was, and vice versa (p=0.032; p=0.044; p=0.04, statistically significant in all cases).

Patients undergoing repeated transplantation had higher levels of

anxiety (statistically significant) and depressive symptoms on the 21st day after hematopoietic stem cell transfusion compared to patients who had a first transplant (p=0.024; p=0.39). Most likely, this was due to the fact that the former had the experience in preparing and undergoing BMT, but understood that, from the prognosis point of view, the most indicative and ambiguous period would be the period of time from the day of the operation to the hundredth day after it.

Discussion

A study of memory in patients with hematologic malignancies treated with hematopoietic stem cell transplantation showed that mediated memory decreases from the first stage to the second, which may be a consequence of the toxic effects of the conditioning regimen before BMT. All averaged values of mediated memory assessments demonstrated by patients during the study were at the upper limit of low values. Presumably, this can be explained by the courses of chemotherapy performed before BMT, aimed at achieving remission. Thus, a comparative study of the cognitive functions of colorectal cancer patients undergoing chemotherapy treatment and the patients treated with alternative methods also proved that nonspecific toxic treatments negatively affect memory performance [11].

No statistically significant differences were found between the characteristics of short-term and long-term memory of patients, but their decrease over time was revealed, as demonstrated by averaged data at each stage. It can be assumed that with an increase in the number of participants in the study, the difference between measurements will be more pronounced. In addition, only those patients who had the least severe complications and whose condition, as a result, was stable could take part in the study on the 60th day after BMT. Such hematological

oncology patients could be called safer compared to those patients who could not talk with the psychologist because of their poor condition.

The values of mechanical memory assessments on the 21st and 60th days after BMT differ statistically significantly: at the third stage, patients demonstrate lower assessments relatively to the first stage, which may be a manifestation of the toxic effect of treatment on the cognitive functions of patients. The characteristics of logical memory do not change statistically significantly, which may be due to the factors listed above. One can also assume the influence of the learning effect, which manifests itself due to the short period of time between measurements. In addition, there is a point of view that different cognitive impairments and their severity can be detected in the long term [11].

A direct relationship was found between the improvement of some memory parameters at the third stage of the study and the recommendations given based on the results of the second stage of the study. Positive dynamics observed in patients performing individually selected exercises suggests that the training of cognitive functions helps to maintain and improve their level. To confirm this position, you can refer to the Neuropsychological Rehabilitation Manual by G. Lubrini, which describes the principles of constructing rehabilitation programs after chemotherapy based on cognitive training [12].

The average assessment values in terms of operative memory and span, attention-switching are at the level of low values at all stages of the study, except for the third: on the 60th day after bone marrow transplantation they are characterized as normal but take the lower limit of values.

A comparative analysis of attention parameters revealed their decrease in patients on days 21 and 60 after hematopoietic stem cell transplantation. Most likely, this is due to the toxic effect of treatment,

which is consistent with the results of studies of chemotherapy effects: attention impairments appear earlier than other cognitive impairments and are characterized by more pronounced declines [11, 13].

In addition, the absence of statistically significant differences in the characteristics of concentration and attention stability between the first, second and third stages of the study may be a consequence of the implementation of individually selected recommendations aimed at improving those cognitive functions that turned out to be below the reference ones. Of course, a learning effect cannot be ruled out, which may also explain the results obtained.

While speculating on what factors may explain the results obtained, it is impossible to ignore the unstable emotional state of patients. A study on the condition of patients with ovarian cancer revealed a relationship between affective and cognitive disorders in patients [14].

The severity of depressive symptoms decreased during the treatment with bone marrow transplantation in all patients, which is due to the fact that most patients assessed the moment of hematopoietic stem cell transfusion as the most significant and emotionally difficult. In addition, it can be assumed that the level of severity of depressive symptoms will be higher in patients who have suffered severe complications and autoimmune reactions of transplant rejection; however, due to their severe, unstable somatic condition, they did not participate in the study. A study of depressive symptoms and their relationship with chronic illness, conducted in Pennsylvania, confirmed this assumption: the more severe and prolonged is the exacerbation, the more severe depressive symptoms are, and vice versa [15].

The second component of the emotional state of patients – situational anxiety and personal anxiety – also showed a statistically significant decrease from the study first stage to the third one.

Presumably, this can be explained by a general decrease in tension after transfusion of hematopoietic stem cells, which is confirmed by the results of studying the severity of depressive symptoms and a survey of patients.

A relationship was found between following the recommendations and the dynamics of situational anxiety: patients who performed training exercises showed lower anxiety at the third visit. We can assume that it was easier for low- and moderately anxious patients to concentrate on exercises to preserve cognitive functions; but the opposite effect was also possible.

The results of the emotional state study indicate a direct relationship between the severity of depressive symptoms and the level of situational anxiety, which has also been revealed in a number of other current studies. At the same time, many contemporary authors emphasize the difficulty of distinguishing between these two conditions: depressive and anxiety symptoms. Thus, exploring various manifestations of anxiety and depression, G. Simon, R. Gater, S. Kisely et al. found virtually no differences [16].

Patients who underwent repeated hematopoietic stem cell transplantation demonstrate more pronounced depressive symptoms before surgery, which may be associated with a short period of time between operations and be explained by the depressive stage of accepting the fact of the need for repeated BMT. In addition, these patients demonstrate higher situation anxiety scores at day 21 compared to patients undergoing a first-time bone marrow transplant. Most likely, this is due to the existing negative experience of complications and graft rejection after surgery.

The results obtained indicate that the problem of the toxic effect of treatment with hematopoietic stem cell transplantation on the cognitive functions of hematological cancer patients. In addition, the experience obtained in patients' who followed the individually selected

recommendations and displayed their positive effect on higher mental functions indicates the need to create an interdisciplinary rehabilitation program.

Thus, as a result of the study, we have found that most of the parameters characterizing memory are initially at a level of low values, and also decrease throughout the study. The results of assessing the memory indicate that its level is predominantly normal; the attention-switching attention assessments decrease from the study second stage to the third one. The affective sphere before bone marrow transfusion is represented by depressive symptoms at the level of a subdepressive state and the upper limit of a moderate level of situational anxiety; the above assessments have decreased gradually by the third stage of the study.

Against the background of intense negative experiences of patients undergoing BMT associated with the surgery outcome, as well as with highly toxic medications, the cognitive functions are significantly impaired in patients with hematological malignancies. There is a decrease in assimilation and distortion of information, which in turn can negatively affect the level of compliance, which is vital for patients.

The emotional state of patients improves throughout the follow-up period: from the start of preparation for BMT to the start of the recovery period.

During the study, a decrease in the levels of indirect, short-term, long-term and mechanical memory was found; a similar trend was observed in concentration and attention-switching characteristics.

At the same time, the results of patients who followed recommendations for training the cognitive functions are positively different from the results of patients who, for various reasons, did not resort to exercise. This, in turn, indicates a high rehabilitation potential for patients. In this regard, the results obtained can be used in the

development of rehabilitation programs for hematological cancer patients, as well as during psychological support of treatment to minimize cognitive and emotional disorders, as well as to identify psychotherapeutic targets.

In the future, it is necessary to conduct a larger scale longitudinal study using the longitudinal section method to obtain more detailed results, on which basis it would be possible to develop a rehabilitation program for hematological oncology patients undergoing treatment with hematopoietic stem cell transplantation.

Conclusions

1. In patients with hematological malignancies, most memory parameters are in the range of low values. On the 21st day after transplantation, the parameter of mediated memory tends to decrease relatively to that one in the period before surgery ($p=0.082$).

2. Concentration and attention-switching capability in hematological oncology patients before hematopoietic stem cell transplantation are characterized by normal values. There is a statistically significant decrease in the attention-switching capability on the 60th day after surgery ($p=0.033$). Spatial orientation and attention span in patients with hematological malignancies are in the range of normal values and decrease significantly on the 60th day after bone marrow transplantation. A downward trend was observed throughout the study.

3. Spatial orientation and attention span in patients with hematological malignancies are within the normal range and statistically significantly decrease on the 60th day after bone marrow transplantation ($p=0.012$). A decrease in this parameter was observed throughout the study (from $p=0.02$ (statistically significant) to $p=0.07$).

4. Situational and personal anxiety parameters gradually

decrease throughout the study: from the period before hematopoietic stem cell transplantation, becoming statistically significant on the 21st day after hematopoietic stem cell transplantation (p=0.004), and then as a trend until the 60th day after it (p=0.075).

5. The severity of depressive symptoms corresponds to the subdepressive state values seen before bone marrow transplantation, as well as on the 21st day after the operation, while as soon as on the 60th day after the transfusion, the average value decreases, thereby indicating the absence of affective disorders (p=0.024, p=0.036, p=0.014, statistically significant in all cases).

References

1. Chulkova VA, Moiseenko VM. Psikhologicheskie problemy v onkologii. *Practical oncology.* 2009;10(3):151–157. (In Russ.).

2. Fedorova SYu, Vybornykh DE, Khrushchev SO, Drokov MYu, Gemdzhyan EG, Kuzmina LA, et al. Therapy of cognitive impairment in patients undergoing allogeneic hematopoietic stem cell transplantation. *Mental disorders in general medicine.* 2019;(1):4–14. (In Russ.).

3. Belyaev AM, Chulkova VA, Semiglazova TY. (eds.) *Onkopsikhologiya dlya vrachey-onkologov i meditsinskikh psikhologov: rukovodstvo.* St. Petersburg: Lubavitch Publ.; 2017. (In Russ.).

4. Ignatova ES. *Psikhodiagnostika.* Perm. gos. nats. issled. un-t Publ.; 2018. (In Russ.).

5. Batarshev AV. *Bazovye psikhologicheskie svoystva i samoopredelenie lichnosti: Prakticheskoe rukovodstvo po psikhologicheskoy diagnostike.* St. Petersburg: Rech Publ.; 2005. (In Russ.).

6. Luriya AR. *Vysshie korkovye funktsii cheloveka.* St. Petersburg: "Izdatel'skiy dom "Piter" Publ.; 2018. (In Russ.).

7. Mosolov SN. *Shkaly psikho-metricheskoy otsenki simptomatiki*

shizofrenii i kontseptsiya pozitivnykh i negativnykh rasstroystv. Moscow: Novyy tsvet Publ.; 2001. (In Russ.).

8. Reitan RM, Wolfson D. Category Test and Trail Making Test as measures of frontal lobe functions. *Clin Neuropsych.* 1995;9(1):50–56.

9. Zotov MV. *Kognitivnye narusheniya i vozmozhnosti ikh kompensatsii u bol'nykh shizofreniey s razlichnoy stepen'yu vyrazhennosti defekta:* Cand. psychol. sci. diss. Synopsis. St. Petersburg, 1998. Available at: https://new-disser.ru/_avtoreferats/01000214459.pdf [Accessed September 28, 2023]. (In Russ.).

10. Beck AT. *The diagnosis and management of depression.* Pennsylvania: Pennsylvania Press; 1967.

11. Vardy JL, Dhillon HM, Pond GR, Rourke SB, Bekele T, Renton C, et al. Cognitive function in patients with colorectal cancer who do and do not receive chemotherapy: a prospective, longitudinal, controlled study. *J Clin Oncol.* 2015;33(34):4085.

12. Lubrini G, Periáñez J, Ríos-Lago M. (eds.) *Cognitive stimulation and neuropsychological rehabilitation.* Open University of Catalonia; 2009.

13. Sato C, Sekiguchi A, Kawai M, Kotozaki Y, Nouchi R, Tada H, et al. Postope-rative structural brain changes and cognitive dysfunction in patients with breast cancer. *PloS One.* 2015;10(11). https://doi.org/10.1371/journal.pone.0140655

14. Petrova NN, Belozer AS. Cognitive and affective disorders in ovarian cancer patients. *Psychiatry, psychotherapy and clinical psychology.* 2019;10(3): 451–460. (In Russ.).

15. Zhong H, Tammali R, Chen C, Fazenbaker C, Maureen K, Monks N, et al. Synthetic lethal targeting of BRCA mutant tumors with antibody linked pyrrolobenzodiazepine dimers. *Cancer Res.* 2017;77(13);76.

16. Simon G, Gater R, Kisely S, Piccinelli M. Somatic symptoms of distress: an international primary care study. *Psychosomatic medicine.* 1996;58(5):481–488

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