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Physical Rehabilitation of Patients After Ischemic Stroke

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The high prevalence of ischemic stroke and high mortality from it with increasing disability of such patients currently makes the problem of vascular diseases of the brain one of the most socially significant and requiring additional research. Conducting physical rehabilitation in post-stroke patients according to the author's scheme had a pronounced positive effect on their hematological parameters, regardless of their initial state. Wellness measures ensured in all patients who had an ischemic stroke a gradual optimization of the number of red blood cells, white blood cells and platelets in the blood. The upcoming changes created conditions for improving trophic tissue of patients, increased their overall reactivity and minimized the risk of repeated ischemic damage to brain tissue. The results suggest that the author's option of rehabilitation of post-stroke patients is highly promising in terms of ensuring adequate activation of the bone marrow regardless of the initial level of erythropoiesis, leukopoiesis and thrombocytopoiesis. This prevents anemia, weakening of resistance and thrombophilia in such patients, optimizing the general condition and significantly improving the prognosis for the disease and for life.

Keywords: Blood, Blood cells, Ischemic stroke, Rehabilitation, Health.

Recently, vascular lesions of the heart and brain are becoming more and more common in the world[1]. Their formation is based on atherosclerosis[2], arterial hypertension[3] and various metabolic disorders[4]. Statistics show that vascular pathology of the brain is becoming one of the leading causes of mortality and disability in different countries of the world[5,6]. Occlusion of the vessels supplying the brain is the initial link in the chain of adverse changes leading to gross disorders of neuronal metabolism, the development of their structural and functional changes, often ending in nerve cell death[7]. Acute or chronic ischemia of the brain tissue leads to a cascade of pathological reactions that can lead to the development of focal neurological deficit, progression of discirculatory encephalopathy, and often to the death of the patient[8,9].

The high prevalence of vascular diseases of the brain, high mortality from them, and the risk of developing disability against their background, often already at working age, make them one of the problems of special social significance[10].

It has been proven that the most complete recovery occurs in the first 3-6 months after a stroke. For this reason, the earliest possible start of

rehabilitation is necessary, which would maximize the patient's condition, maximize his self-care skills, speed up his inclusion in society and improve his psycho-emotional state[11,12].

Given the severe consequences of a stroke, the high risk of disability against its background in the case of unsatisfactory rehabilitation in many respects seemed to be relevant to develop and test the author's version of physical rehabilitation for patients who have recently suffered an ischemic stroke[13,14].

Objective: to evaluate the effect of the author's scheme of physical rehabilitation on the levels of blood cells during the early stages of the correction of motor skills in patients after ischemic stroke.

MATERIALS AND METHODS

The study was approved by the local ethics committee of the Russian State Social University on September 15, 2015 (protocol ¹9).

The study was performed on patients aged 50 to 65 years who underwent treatment in the city clinical hospital named after S.P. Botkin in Moscow from December 2015 to December 2016 in the Department of Neurology with a diagnosis of "ischemic stroke" of various localization.

To carry out rehabilitation according to the author's scheme, 44 people were selected who suffered an ischemic stroke a day ago. They made up an experimental group. From the day of admission to the hospital, all these patients received rehabilitation according to the author's scheme. The control group was recruited from 35 patients after an ischemic stroke who refused to carry out any physical rehabilitation. Drug therapy was standard in both groups and was no different.

Author's physical rehabilitation was carried out for 30 days and consisted of the following events:

1. Position treatment was applied from the first day after a stroke and consisted of 3 main provisions of the patient: laying on the back, laying on the healthy side, laying on the affected side with the physiological position of the limbs.
2. The use of passive ideomotor and active exercises. Passive exercises started simultaneously with the treatment by the position, performed on the sick and healthy side, at a slow pace, in full, in isolation in each joint with a number of movements from 2-4 to 8-10. Classes with idiomotor exercises were conducted for 10 minutes daily from the first day of admission to the hospital. They consisted in the presentation of the work with the hand and foot of the affected side while performing the same exercises on the healthy side. Active movements in the form of therapeutic physical culture began 5-7 days after ischemic stroke. These exercises always began to be performed with healthy limbs. This program was used in all patients of the experimental group for 40-45 minutes per day.

Starting from the 10th day, the patients of the experimental group conducted standard exercises of breathing gymnastics by A. N. Strelnikova in the amount of 10 exercises per day, from the 15th day of the pack 15 exercises were carried out.

Also, physiotherapeutic procedures were carried out with all patients of the experimental group, starting from the third week (from day 15), which included electrical stimulation of the affected limbs in combination with acupuncture.

The motor activity of patients in the control group was carried out only at their request, in a certain mode, they refused a further course of physical therapy, their motor activity included walking, walking along the corridors of the department and self-care.

In all patients under observation, the blood concentrations of leukocytes, erythrocytes and platelets were determined using an ADVIA 60 instrument (Bayer Health Care LLC, USA). For the study, venous blood was used, which was taken on the first, fifth, tenth, fifteenth, twentieth, twenty-fifth and thirtieth days after a stroke.

The obtained digital values were processed using Student's criterion.

RESEARCH RESULTS

Patients taken under observation, who agreed to undergo rehabilitation according to the author's method, in the outcome had a different number of red blood cells and platelets in the peripheral blood. Given this circumstance, patients with a high initial amount of red blood cells and platelets in the blood were monitored separately from patients who had their low concentrations.

The physical rehabilitation of patients who had an ischemic stroke had a positive effect on their general condition and on the hematological parameters taken into account.

It was found that the number of red blood cells in individuals from the experimental group who had a low concentration of red blood cells, by 10 days of observation tended to decrease relative to control values, subsequently continuing to decrease by 15 days and becoming significantly lower than the control ($p<0.05$) (table 1). By 20 days of the study, there was a significant growth ($p<0.02$) of red blood cells relative to the control while maintaining these changes until the end of the observation. This pattern, apparently, is due to the best adaptation of patients to current living conditions as a result of the use of author's physical rehabilitation.

The number of red blood cells in individuals of the experimental group who

Table 1. The effect of physical rehabilitation on the concentration of red blood cells in the peripheral blood of patients who initially had fewer red blood cells ($\times 10^{12}$/l)

Dates of Observation	Control group, M±m, n=19	Experienced group, M±m, n=23	Value p
1 day	3.9±0.05	3.9±0.06	0.21
5 day	3.8±0.08	3.8±0.01	0.15
10 day	3.9±0.01	3.8±0.06	0.10
15 day	3.8±0.01	3.8±0.04	0.05
20 day	3.7±0.02	3.9±0.01	0.02
25 day	3.8±0.02	3.9±0.03	0.02
30 day	3.7±0.02	3.9±0.03	0.05

Table 2. The dynamics of the concentration of red blood cells ($\times 10^{12}$/l) against the background of the rehabilitation in patients with a large initial concentration

Dates of Observation	Control group, M±m, n=16	Experienced group, M±m, n=21	Value p
1 day	5.1±0.04	5.0±0.04	0.23
5 day	4.9±0.05	4.9±0.05	0.25
10 day	5.0±0.05	4.9±0.04	0.15
15 day	5.0±0.05	4.8±0.04	0.05
20 day	4.8±0.04	4.8±0.03	0.05
25 day	4.9±0.05	4.8±0.04	0.02
30 day	4.6±0.05	4.8±0.05	0.02

Table 3. The dynamics of the number of leukocytes in the blood ($\times 10^{9}$/l) in patients after ischemic stroke

Dates of Observation	Control group, M±m, n=35	Experienced group, M±m, n=44	Value p
1 day	13.9±0.26	13.1±0.28	0.22
5 day	13.2±0.24	12.4±0.25	0.24
10 day	13.1±0.22	11.4±0.21	0.05
15 day	12.8±0.22	10.6±0.18	0.02
20 day	12.7±0.21	10.3±0.18	0.001
25 day	12.2±0.21	9.9±0.16	0.001
30 day	11.9±0.39	9.4±0.17	0.001

Table 4. Dynamics of platelet level ($\times 10^9$/l) during rehabilitation in patients who had their initial low level

Dates of Observation	Control group, M±m, n=19	Experienced group, M±m, n=23	Value p
1 day	177.1±0.43	166.5±0.20	0.33
5 day	167.8±0.32	165.5±0.16	0.27
10 day	178.8±0.19	167.0±0.12	0.15
15 day	186.6±0.27	168.6±0.41	0.07
20 day	194.8±0.29	165.5±0.32	0.05
25 day	205.8±0.18	169.1±0.28	0.05
30 day	210.3±0.14	170.0±0.30	0.05

Table 5. Dynamics of platelet count ($\times 10^9$/l) during rehabilitation in patients who had their initially high concentration

Dates of Observation	Control group, M±m, n=16	Experienced group, M±m, n=21	Value p
1 day	292.0±0.31	322.8±0.42	0.16
5 day	290.0±0.48	310.5±0.48	0.10
10 day	286.5±0.29	296.1±0.34	0.13
15 day	284.8±0.40	285.1±0.27	0.07
20 day	283.6±0.51	278.3±0.35	0.05
25 day	279.8±0.26	264.0±0.18	0.05
30 day	276.5±0.35	244.5±0.24	0.05

had a large number of red blood cells in the outcome (table 2), tended to increase by 5 days of observation, then by 10 days of observation - to decrease relative to control values. Subsequently, this indicator continued to decrease and by 15 days it became significantly lower than the control ($p<0.05$). By 20 days of observation, there was a significant increase ($p<0.02$) in the number of red blood cells relative to the control, which remained until the end of the study.

It can be argued that the reaction of erythropoiesis to the author's physical rehabilitation was more pronounced in patients with a large initial level of red blood cells.

White blood cells in all patients of the experimental group had a downward trend by 5 days of observation. By the tenth day of observation, this dynamics became reliable ($p<0.05$). In the subsequent follow-up periods, patients until the end of the study maintained a reduced level of white cells in peripheral blood.

The data on the reaction of leukocytes in peripheral blood to the physical rehabilitation performed in patients after an ischemic stroke indicate the development of a decrease in inflammatory processes.

In patients who had an initially low platelet count, there was a tendency to increase them within physiologically acceptable values (table 4).

Found a slight tendency to increase the level of platelets in the experimental group completely excluded their risk of thrombosis. Moreover, the increase in platelet count in the blood of individuals in the control group was more pronounced, but also did not go beyond the generally accepted norm. In patients who had an initially high platelet count, positive dynamics of their level was also noted against the background of their physical rehabilitation (table 5).

As the period after a stroke increased, the number of platelets in the blood of patients of both

groups decreased, but in the experimental group this was much more pronounced. The achieved decrease in their number in the blood of patients of both groups indicated a lower risk of repeated thrombotic episodes.

DISCUSSION

The results obtained during the study confirm the prevailing scientific opinion that hematopoiesis is closely related to the general condition of the body and is sensitive to the appearance of pathology in any organ[15]. This is explained by the fact that with the development of disorders in the body, the level of hematopoietins in the blood and in the bone marrow inevitably changes. Moreover, the severity of these changes can be very individual[16]. There is reason to believe that with ischemic stroke, the regulatory effects of the brain on the bone marrow are very pronounced, which leads either to anemia with a tendency to thrombocytopenia, or to an increase in the number of red blood cells and platelets in the peripheral blood. However, in all cases, leukocytosis occurs, which is a consequence of the implementation of the response of the immune system to damage to brain tissue[17].

Conducted rehabilitation effects were able to boost the General condition of the patients and improved the accounted value in their blood. Taken under the supervision of the patients gave consent to undergo rehabilitation by the methodology, the outcome had in the peripheral blood of a different number of red blood cells and platelets. For this reason, patients with a high initial number of blood erythrocytes and platelets were assessed separately from patients who had low concentrations. Carried out their physical rehabilitation in all cases had a positive impact on their General condition and consider them hematological parameters. To explain the optimization of these parameters is possible when optimum levels of hematopoietic cells in the blood and normalization of production in the bone marrow formed elements of blood[18,19]. Developing changes to the end of the study contributed to a better adaptation of patients to the current conditions of life, improving they have a "margin of safety" in their bone marrow against the backdrop of the author's physical rehabilitation.

Found the response of erythropoiesis to the author's physical rehabilitation was more pronounced in patients with higher baseline levels of red blood cells[20]. Previously, it was demonstrated that the extreme situation in humans, who had a peripheral blood source, a large number of red blood cells, leading to a significant decrease in their number, but at low initial level, this reduction is very small[21].

Held the author's physical rehabilitation provided marked reduction in level of leukocytes in the peripheral blood of patients with ischemic stroke. This indicated the possibility of treatment applied to reduce the activity of mechanisms that support inflammation in the body[22].

In the blood of patients of the experimental group, regardless of the initial level of platelets is marked by a gradual optimization to physiologically acceptable values[23]. Revealed a decrease in the level of platelets in the blood of individuals of the control group of stroke survivors was much less pronounced than in the experimental group. Achieve changes in the number of platelets in the blood of patients of the experimental group observation indicated a real drop they have a risk of thrombotic episodes[24,25], to thereby minimize they risk of recurrent stroke, emphasizing the preference of use of author's physical rehabilitation after ischemic stroke[26,27].

CONCLUSION

The high prevalence of ischemic stroke, a serious risk of the occurrence on the background of disability put forward at the present time, the vascular pathology of the brain to the forefront of science. Conducting of post-stroke patients with physical rehabilitation copyright scheme optimized the level of their hematological parameters, regardless of their initial state. Data rehabilitation measures were provided in all patients with ischemic stroke, a gradual normalization in blood of quantity of erythrocytes, leukocytes and platelets. Developing changes to improve the trophic tissue of patients increased their overall reactivity and reduced the risk of recurrent ischemic stroke. Based on the results obtained, it can be considered the author's version of post-stroke rehabilitation patients highly promising in terms of ensuring the normalization of the functioning of the bone marrow in post-stroke patients regardless

of the source of their level of erythropoiesis, leucopoiesis and thrombocytopoiesis. It prevents such patients have anemia, weakening resistance and thrombophilia, which optimizes the overall condition and significantly improves the overall prognosis.

Conflict of interest

No conflict of interest is declared.

Sources of financing

The study was conducted at the expense of the authors.

Ethics Committee Resolution

The study was approved by the local ethics committee of the Russian State Social University on September 15, 2015 (protocol ¹9).

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