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Diagnosis of Violations of Microcirculation in the Late Recovery Period after Thrombosis of Cerebral Vessels

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Abstract

There is no objection that many pathological manifestations after thrombosis of cerebral vessels are associated in many respects with microcirculation disorders. These dysfunctions of microcirculation on the side of the lesion in patients are increasingly considered a point of influence for the recovery of this contingent of patients. In this connection, it is required to clarify the state of microcirculation in post-stroke patients at the late stage of their rehabilitation. In the article, the state of microcirculation in patients was clarified 7 months after the stroke. It was found that the deterioration of microcirculation processes is very typical for this contingent of patients, especially on the paretic side. Apparently, improvement in the state of motor function in patients after thrombosis of cerebral vessels is associated with increased microcirculation in affected limbs and in healthy limbs. The disturbances of microcirculation persisting in patients give grounds to recommend such a combination of drug treatment and non-medicamentous effects in the late stages of recovery, using the latter particularly actively on the affected side.

Keywords: Thrombosis of cerebral vessels; Late recovery period; Microcirculation; Vascular tone; Blood flow

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Introduction

The viability of mammals has long been in the focus of attention of modern researchers [1-3]. It becomes clear that it depends on the mass of environmental factors [4-7] and shifts in the body's homeostasis [8-10]. Particular attention, among other things, attracts to itself blood, which is the environment of the organism and capable, by changing liquid properties, to influence the state of many vital processes [11].

Hemorheology is an important basis for all life processes of mammals [12-14] and human [15,16]. It provides the necessary metabolic processes in the body [17,18] and maintains the necessary level of adaptation [19-21] to the constantly changing environmental conditions [22-24]. In this connection, hemorheological properties of blood in vessels of different caliber and their connection with hemostasis are increasingly being studied in animals [25] and in humans [26,27] in norm and pathology [28-30]. The modern medicine pays special attention to hemorheological changes in vascular thrombosis [31-33].These include cerebral stroke, which does not currently reduce its prevalence among the population of developed countries [34]. The prevalence of thrombosis of cerebral vessels is now very high and continues to grow. In this regard, the continuation of the study of the pathological manifestations of thrombosis of cerebral vessels, which greatly contributes to the disability of the population, is of particular importance. In patients who have suffered it, the bulk does not return to its habitual way of life and work activity [35].

A major problem for post-stroke patients is motor impairment. Currently, it is recognized that they are based largely on violations of peripheral microcirculation [36]. In this connection, these microcirculation disorders in the paretic limb are attracting increasing attention of researchers seeking to increase the effectiveness of complex multidisciplinary rehabilitation in this contingent [37]. In this connection, it is necessary to assess the level of microcirculatory disorders that occur after thrombosis of cerebral vessels at the later stages of their rehabilitation. This information can help improve the efficiency of rehabilitation of this category of patients and prolong their life.

Materials and Methods

The research was approved by the Ethics Committee of Peoples Friendship University of Russia (record №5 from 12.05.2014). 62 patients with an age from 45 to 75 y, including 36 men and 22 women who had had an ischemic stroke earlier, were examined. All patients gave written informed consent. Their examination was performed in the late (after 7.0 ± 0.47 months) recovery period after thrombosis of cerebral vessels.

The presence of ischemic stroke in each patient was confirmed by anamnesis, clinical picture, laboratory indicators, and the results of computed tomography of the brain. All patients had mild or moderate hemiparesis.

The study included patients with arterial hypertension. Their studies excluded patients who had diabetes mellitus, severe cardiac, hepatic or renal insufficiency and oncological diseases.

The control group was represented by 34 clinically healthy volunteers aged 45-75 (15 men and 19 women).

The study was carried out using laser Doppler flowmetry (LDF) using the LAKK-04 device manufactured by Lazma (Russia). In the course of this study, several indicators of microcirculation were taken into account: MP (microcirculatory parameter), expressed in terms of perfusion. He spoke about the state of perfusion associated with erythrocyte exponents. The mean square deviation (RMS) of the counted signals from the mean value or the value of the flag was taken into account. Analysis of amplitude-frequency characteristics of hemodynamic changes in tissue vessels was carried out at frequencies from 0.01 to 1.2 Hz. In the blood flow fluctuations, the following intervals were taken into account in studies: very low frequency (0.01-0.03 Hz) oscillations (VLF), they reflected the role of humoral-metabolic influences on microhemodynamics; low frequency (0.05-0.15 Hz) oscillations (LF) caused by periodic contraction of smooth myocytes of arterioles; high frequency (0.2-0.4Hz) oscillations (HF) associated with the dynamics of pressure in venous vessels; high-frequency (1.0-1.2 Hz) fluctuations (CF) of the pulse. The study took into account the contribution (P %) of different rhythmic oscillations on the LDF-gram, which were estimated from their percentage of the value of the flaxmation [38]. The value of the index of flaxemias was calculated as a partial active change in blood flow in the skin: IFM=ALF / (ANF+ACF). In the work, respiratory and occlusive tests were performed.

Statistical analysis of the results obtained in the work was carried out with the help of the program "Statistics 6.0" by applying the methods of parametric and nonparametric analysis (Student and Mann-Whitney criteria). The level of significance in the study was $p<0.05$ (Table 1).

Results and Discussion

In patients in the study during the late recovery stage after thrombosis of cerebral vessels, mild hemiparesis was detected and only 2 patients had moderate hemiparesis. All patients on the side of the paresis recorded pronounced disorders of microcirculation associated with inhibition of blood flow in the lumen of the capillaries and due to excessive aggregation of erythrocytes. Microcirculation parameters were variable, and the level of the cell would be reduced. In the frequency-amplitude spectrum in all cases, the LF-rhythm waves were reduced. In patients, a slight decrease in the amplitude and level of the contribution of the HF rhythm was noted. This was accompanied by a slight decrease in the amplitude and the value of the contribution of the CF rhythm with a decrease in the value of the index of fluctuations. On a healthy limb, all patients with microcirculatory disorders were not identified.

The negative changes in microcirculation in the affected limb found in patients are undoubtedly caused by a decrease in blood flow and a weakening of its outflow in the capillary bed. Apparently, this is due to a change in the lumen of the arteries and venules, their expansion and an increase in the degree of tortuosity of the venules.

All patients who underwent thrombosis of cerebral vessels, in addition to disorders of central hemodynamics, had microcirculation disorders mainly in the paretic limbs of patients.

Deterioration of peripheral hemodynamics was noted in all patients at a late stage of recovery after thrombosis of cerebral vessels on the affected side. Apparently, the positive dynamics achieved in the motor sphere in the patients observed at the late stage of recovery is

Table 1. Hemodynamic parameters in the early recovery period of ischemic stroke.

Parameters of LDF-gram	**Early recovery period, M ± m, n=58**		**Control, M ± m, n=34**
	Healthy limb	Paretic limb	
Parameter of microcirculation, perfusion units	8.4 ± 0.35	8.2 ± 0.63 p<0.05	8.6 ± 0.47
The level of the flask (mean square deviation), perfusion units	0.98 ± 0.033 p_1<0.05	0.91 ± 0.023 p<0.05	1.04 ± 0.055
Index of flaxemias, conventional units	0.33 ± 0.011 p_1<0.05	0.29 ± 0.20 p<0.05	0.34 ± 0.16
Very low frequency (VLF) oscillations, Hz	0.42 ± 0.015 p_1<0.05	0.35 ± 0.019 p<0.05	0,43 ± 0,014
Low-frequency (LF) oscillations, Hz	0.27 ± 0.008 p_1<0.05	0.24 ± 0.010 p<0.05	0.28 ± 0.009
High-frequency respiratory vibrations (HF), Hz	0.16 ± 0.005	0.13 ± 0.011 p<0.05	0.18 ± 0.006
High-frequency pulse (CF) oscillations, Hz	0.63 ± 0.007	0.56 ± 0.020 p<0.05	0.66 ± 0.012
%contribution VLF	26.8 ± 0.40 p_1<0.05	23.1 ± 0.33 p<0.05	27.5 ± 0,59
%contribution LF	18.5 ± 0.14 p_1<0.05	16.2 ± 0.16 p<0.05	19.2 ± 0.25
%contribution HF	12.0 ± 0.20 p_1<0.05	10.0 ± 0.15 p<0.05	12.7 ± 0.12
%contribution CF	42.0 ± 0.10 p_1<0.05	38.1 ± 0.17 p<0.05	42.3 ± 0.21
Vascular tone, units	3.9 ± 0.15 p_1<0.05	4.2 ± 0.20 p<0.05	3.8 ± 0.16
Degree of decrease in blood flow in the respiratory sample,%	33.2 ± 0.26 p_1<0.01	24.1 ± 0.16 p<0.01	40.0 ± 0,11
Reserve of capillary blood flow,%	147.0 ± 0.71 p_1<0.01	132.2 ± 0.045 p<0.01	159.1 ± 0.25

associated with a positive dynamics of the microcirculation parameters on the lesion side and, to a lesser extent, on the healthy limbs.

The microcirculation disorders that persist at the time of the examination give grounds to recommend the appointment of dezaggregants, venotonics, vasodilators, massage sessions, reflexology, physiotherapy, and exercise therapy in patients with late stages of rehabilitation after thrombosis of cerebral vessels.

Conclusion

Impairment of peripheral hemodynamics is very typical for all patients in the late recovery period of ischemic stroke on the paresis side. There is reason to believe that the positive dynamics on the part of the motor sphere in patients in the late recovery period is associated with an improvement in microcirculation parameters on the paresis side and on healthy limbs. The remaining disorders of the microcirculatory link allow recommending patients who underwent ischemic stroke in the late recovery period the use of disaggregates and the use of non-drug effects, primarily on the diseased limb, to ensure the fullest possible rehabilitation.

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