CHARACTERIZATION OF LIPID PEROXIDATION IN PATIENTS WITH EARLY STROKE RECOVERY PERIOD AT THE STAGES OF COMPLEX REHABILITATION

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There were carried out biochemical testing methods in 20 invalids (13 men and 7 women) with the consequences of cerebral stroke in early recovery period. Analyses of blood antioxidant system of the patients in early stroke recovery period showed high level of accumulation of metabolites of lipid peroxidation in blood and reduction of activity of antioxidant system. The evidence confirms the need to add antioxidants into stroke complex rehabilitation therapy.

Keywords: consequences of stroke, lipid peroxidation, antioxidant system

Brain vascular diseases are the major causes of disability and mortality of the patients due to their high rates worldwide that are increasing because of the growth and aging of the population. Stroke is an acute and most dangerous form of cerebrovascular diseases that creates a serious medical and socioeconomic problem. Its significance especially grows in the patients, who have previously suffered from cerebral stroke (Balunov, 1994; Vereshchagin et al., 1999) [1, 5].

In recent years, no biochemical agents have been studied as intensively as system of lipid peroxidation (LP). Burlakova E.B. (1997), Ibragimov U.K. et al. (1998) considered that LP is one of the important regulatory systems involved in maintaining homeostasis, adaptation to adverse effects, and the regulation of metabolic cell processes. According to the authors, the most intensive and continuous free radical oxidation in the lipid layer of biological membranes is enhanced by brain hypoxia due to cerebrovascular accidents [3, 4]. As a result of LP and enhanced consumption of antioxidants increases the content of intermediate and final products of LP in blood, which significantly impairs the functioning of nerve cells (Burlakova E.B. et al., 1995) [2].

Despite advances in recent years in studies on physical rehabilitation of post-stroke patients, issues of antioxidant protection of brain during early stroke recovery period are generally not well studied.

The aim of the study was to investigate LP of blood at the consequences of stroke in early recovery period at the stages of complex rehabilitation.

Material and methods

There were studied 20 invalids of working-able age with the consequences of stroke in early recovery period: 13 (65%) male and 7 (35%) female. In 9 (45%) patients an ischemic lesion was located in the left hemisphere of brain, and in 11 (55%) patients – in the right one. According to the degree of disability, patients were divided into the following disability groups: I group – 1 (5%) patient with severe neurological status, II group – 15 (75%) patients with moderate deficiency of neurological symptoms, and III group – 4 (20%) patients with mild degree of neurological disorder. 5 patients with diseases of peripheral nervous system, with the similar gender and age formed the control group.

Common clinical, neurological, and such as paraclinical methods of investigation as Doppler ultrasound of brachycephalic arteries, transcranial dopplerography, electroencephalography (EEG) were used. For the study LP state, laboratory-biochemical blood investigations were performed. The blood samples were received from cubital vein in the morning on admission to the hospital and in 20 days after discharge (in mean of 30 days), and blood serum by centrifugation of whole blood, carefully preserved from hemolysis. The content of malon dialdehyde (MDA) in blood was determined by the method of I.D. Stalnaya, G.G. Garishvili (1977). Results were recalculated the amount of total protein by O.H. Lowry (1951). The level of hydroperoxides (HP) was determined by the method of V.V. Gavrilov et al. (1983) and counted in optical units of the number blood serum lipids. Catalase activity was determined by permanganametric method of S.M. Zubkova and A.N. Bach (1976), superoxide dismutase activity in blood – by the method of P.H. Mirsa and S. Fridrich (1972) [2].

Results and discussion

Biochemical methods were aimed to determine blood antioxidant system (AOS) parameters, particularly the state of free radical oxidation of lipids and activity of AOS enzymes. Studies of AOS in 20 patients with early stroke recovery period showed reduction of activity of AOS enzymes. Activity of catalase and superoxide dismutase in patients on admission day was lower in 1,43 and 1,4 times than in the control group, respectively. Studies of AOS parameters in this group of patients showed activation of free radical oxidation of lipids in several times to the control and reached 1,51 ± 0,14 nmol/mg protein per min. Also, the induced system has detected a similar pattern of enzyme-independent activation and enzyme-dependent inducible peroxidation to 6,77 ± 0,37 and 9,61 ± 0,32 nmol/mg, respectively. Along with this, there was showed an increased amount of HP to 5,94 ± 0,46 U/mg lipids.

Thus, as a result of the carried out investigation, there were revealed changes in AOS of patients with early stroke recovery period, which correlated to a certain extent with the clinic of cerebrovascular disease. In this connection, we suppose that the inclusion of antioxidants into complex drug therapy for stroke is proved and justified as they influence on links of pathogenesis of cerebrovascular pathology. Therefore, patients were divided into 2 subgroups of 10 patients for the comparative assessment of the effectiveness of antioxidant therapy. The first subgroup was subjected to complex rehabilitation without antioxidant therapy (traditional treatment), while the second subgroup additionally to the complex rehabilitation received tocopherol acetate in dosage 50 mg, one capsule 2 times daily for 2 months.

As noted above, the study of intensity of free radical oxidation in blood of patients and invalids in early stroke recovery period showed a high level of accumulation of thiobarbituric acid (TBA) active products in the spontaneous condition in 2,5 times higher the level of control, respectively. In dynamics of traditional treatment, intensity of spontaneous peroxidation in blood of patients in these groups decreased slightly, i.e. not statistically significant ($P > 0,05$). At the same time, the accumulation of TBA-active products in enzyme-independent and enzyme-dependent inducible systems of LP in blood was similar, being higher the parameters of control in 2,3 and 1,6 times, respectively. As a result of traditional therapy, the intensity of induced systems of LP decreased for ascorbate-dependent lipid peroxidation (ADLP) and nicotine amide adenine diphosphate-dependent lipid peroxidation (NDLP) 1,19 and 1,14 times, respectively. Also, there was noted reduction in the contents of HP in blood in 1.1 times in the patients and invalids due to traditional treatment in comparison with the initial levels (table 1).

Table 1

The level of lipid peroxidation in blood of patients in early rehabilitation period of stroke after traditional therapy

Group of patients	Parameters			HP (U/mg lipids)
	Spontaneous	ADLP	NDLP	
	(nmol/mg protein*min)			
Control ($n = 5$)	0,61 ± 0,11	2,9 ± 0,2	6,2 ± 0,2	1,46 ± 0,30
Before rehabilitation measures ($n = 10$)	1,51 ± 0,14	6,77 ± 0,37	9,61 ± 0,32	5,94 ± 0,46
After rehabilitation measures ($n = 10$)	1,41 ± 0,16	5,65 ± 0,29	8,43 ± 0,29	5,37 ± 0,29

Table 1 shows that in blood of patients in early stroke recovery period, who had received traditional therapy, marked LP activation on a background of accumulation of TBA-active products in spontaneous and induced systems, as well as the HP contents. The traditional therapy has decreased the contents of LP products in blood insignificantly, that suggest the necessity to include corrective antioxidant therapy. Status of the AOS was assessed also by activity of protective enzymes catalase and superoxide dismutase in blood (table 2).

Table 2

State of antioxidant system of blood in patients in early stroke recovery period after traditional therapy

Group of patients	Catalase, mmol $H_2O_2/10^9$ erythr. min/	Superoxide dismutase, nmol adrenalin / mg protein min
Control $n = 5$	42,6 ± 0,7	4,4 ± 0,4
Before rehabilitation measures ($n = 10$)	29,8 ± 0,62	3,22 ± 0,31
After rehabilitation measures ($n = 10$)	31,2 ± 0,71	3,28 ± 0,24

As a result of traditional therapy, the activity of catalase and superoxide dismutase remained virtually unchanged (differences are insignificant, $P > 0,05$).

Thus, the increase of LP intensity in blood of patients in early stroke recovery period was observed on a background of decreased activity of the enzymes of AOS. Traditional therapy had no positive effect on intensity of LP in blood and AOS status. We observed LP activation associated with decreased AOS capacity that indicates the long-term disintegrating effect of peroxidation metabolites on protein components of cells and tissues.

In blood of patients in the second subgroup in early stroke recovery period, there was also revealed the increase of accumulation of TBA-active products and reduction of enzymatic activity of AOS. Based on these data, it was recommended the inclusion of antioxidants into complex therapy of stroke. As a result of complex rehabilitation of the patients and invalids in early stroke recovery period with the inclusion of antioxidants, there was noted reduction of HP contents in blood by 1,43 times, compared with the initial level (table 3).

Table 3

The level of lipid peroxidation in blood of patients in early stroke recovery period during complex rehabilitation with the inclusion of antioxidants

Group of patients	Parameters			HP (U/mg lipids)
	Spontaneous	ADLP	NDLP	
	(nmol/mg protein*min)			
Control (n = 5)	0,61 ± 0,11	2,9 ± 0,2	6,2 ± 0,2	1,46+0,30
Before rehabilitation measures (n = 10)	1,56 ± 0,23	7,01 ± 0,24	9,76 ± 0,39	5,95 ± 0,54
After rehabilitation measures (n = 10)	0,91 ± 0,04***	4,59 ± 0,05***	6,45 ± 0,38***	4,17 ± 0,44**

N o t e : * – indicates significant differences $P < 0,05$; ** $P < 0,01$; *** $P < 0,001$

As can be seen from table 3, the level of accumulation of TBA-active products in the spontaneous condition was 2,6 times higher than in control. After rehabilitation treatment with the inclusion of antioxidants the intensity of spontaneous LP in blood of this subgroup of patients decreased by 1,7 times, compared with the initial parameters. Along with this, the accumulation of TBA-active products in the enzyme-independent and enzyme-dependent inducible systems of LP was higher than control in 2,4 and 1,6 times, accordingly. As a result of antioxidant therapy during complex rehabilitation the intensity of inducible systems of LP decreased for ADLP and NDLP 1,53 and 1,5 times, respectively.

The state of AOS was also evaluated on the activity of protective enzymes catalase and superoxide dismutase in blood (table 4).

Table 4

State of antioxidant system of blood in patients in early stroke recovery period during complex rehabilitation with the inclusion of antioxidants

Group of patients	Catalase, mmol $H_2O_2/10^9$ erythr. min	Superoxide dismutase, nmol adrenalin/ mg protein min
Control (n = 5)	42,6 ± 0,7	4,4 ± 0,4
Before rehabilitation measures (n = 10)	28,8 ± 0,73	2,91 ± 0,31
After rehabilitation measures (n = 10)	38,9 ± 0,66**	3,85 ± 0,34**

N o t e : * – indicates significant differences $P < 0,05$; **$P < 0,01$

Hence, rehabilitation with antioxidant correction resulted in increase of the activity of catalase in 1,5 times, and superoxide dismutase in blood in 1,32 times, in comparison with the initial levels.

Conclusion

Thus, the analysis of indicators of antioxidant protection in blood of patients and invalids in early stroke recovery period during complex rehabilitation with the inclusion of antioxidants showed significant reduction in the level of accumulation of metabolites of LP and increased intensity of AOS. As a result, patients and invalids achieved positive changes in laboratory parameters, as well as positive results in partial and complete rehabilitation. The data certainly confirm the necessity to include antioxidant therapy at the stages of complex rehabilitation for stroke.

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