

Physiotherapeutic methods for correcting oxidative stress

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Oxidative stress is prooxidant – antioxidant disbalance and one of the major etiopathogenetic mechanisms of the disease associated with hypoxia and posthypoxia complications, inflammation, metabolic disorder, etc [3, 4, 9, 10, 17, 23, 33-36 and others.].

Prooxidants are activated oxygen metabolites (AOM), active oxygen forms and free radicals of any etiology that activate free radical oxidation of all biomolecules, in particular lipids. In pathology the amount of prooxidants increases and free radical oxidation activation processes of all biomolecules, in particular lipids of biological membranes, go out of control. The accumulation of LPO products, especially final, may damage cell membranes, in particular their lipid bilayer [6, 19]. Lipid peroxidation products produce toxic effect due to biopolymer linking, mitochondrial swelling and division of oxidative phosphorylation, as well as inactivation of enzymes that are involved in breathing and glycolysis. They oxidate proteins, damage DNA, can slow down and even stop division and growth of cells, destabilize cell membranes [8, 34]. As a result, under the influence of lipid peroxidation stability and normal state of cell membranes change as their physicochemical properties - microviscosity of the lipid bilayer and zones of protein-lipid contacts, flow properties, membrane potential, polarity of membrane inner side, membrane proteins modify, ionic permeability of lipid layer changes, its stability decreases - change [9]. All these processes are accompanied by destabilization of cells, in particular erythrocytes, reduction of their deformability, reduction in life expectancy, increase of ectoglobular hemoglobin [7]. Peroxidation makes the cell go around in a vicious circle of bioenergy and homeostasis disorders, which destructs the cell, if not broken.

Inhibition of free radical forms of AOM and chain lipid peroxidation are performed by most bioantioxidants that are regenerated in the body non-stop, as well as come with food or antioxidative drugs. Class of enzymic antioxidants includes catalase, superoxide dismutase (SOD), some peroxidases, oxidoreductase, transferases, etc. Class of nonenzymatic antioxidants is pretty large. In hydrophobic environment oil-soluble tocopherols, ubiquinones, some steroid hormones, A, E, K vitamins and others are active. In hydrophil environment ceruleoplasmin, seleniums, thiol compounds, carnosines and others are active [5, 15, 17]. By the action mechanisms bioantioxidants are often divided into inhibitors of radical oxidative processes and antioxidants [23]. Antioxidants can be either direct or indirect in their effect [16].

Direct antioxidants act *in vivo*, as well as *in vitro*. Commonly antioxidants are functionally connected with each other, can be in synergetic or antagonistic interaction, have a dose-dependent effect [15, 23], and thus the drug-management of the oxidative stress in any pathology can be problematic.

Indirect antioxidants act only *in vivo*, i.e. in the alive systems by stimulating the synthesis of endogenic antioxidants, stabilization of cell membranes and normalization of the metabolic processes. Such an effect can be when using not only chemical substances, but a number of non-drug therapies (ozone therapy, hypercapnotherapy, intravenous laser blood irradiation, extremely high frequency therapy, magnetic therapy, SCENAR-therapy). SCENAR-therapy is biocontrolled low-frequency pulse electrotherapy administered with SCENAR devices (Self Controlled Energo Neuro Adaptive Regulator).

It should be noted that only successive research developments in the field of free radical biology provided the facts that explain some mechanisms of clinical effectiveness of such commonly used non-drug therapies as ozone therapy and hypercapnotherapy. Recent researches on using ozone therapy and hypercapnotherapy in treating cardio-vascular disorders discovered the key clinical and sanogenic action mechanisms of these gas mixtures. The researches have obtained experimental data on multiple antioxidative action of CO₂ as a natural non-enzymic link of the antioxidative protection system and that gave the basis for using this therapy in treatment and prophylaxis in therapeutic facilities [24].

Researches on the effect of medical ozone on the oxidative processes in our body have proved the dose-dependent effect of ozoneoxygen therapy, as well as antioxidative effect manifested as decrease of LPO activity and increase in the activity of the components of the body antioxidative system, in particular, on the first link in the antioxidative protection system - superoxide dismutase of blood plasma [28]. Antioxidative effect of ozonotherapy and dry carbon dioxide baths, as well as other effects of these non-drug therapies, are currently used in the rehabilitation and prophylaxis, in particular of hypertensive disorders in rehabilitation in therapeutic facilities, as well as in the rehabilitation and prophylaxis of ischemic heart disease [2, 24, 28].

Since late 90th the influence of HeNe laser on the processes associated with the oxidative stress are in the focus of the researches. The patients after the course of laser therapy manifested decrease in LPO processes in the blood plasma and erythrocytes in the experiment and clinics [1, 27]. The research proved that intravenous laser blood irradiation (ILBI) provides not only decrease, and can even stop autocatalytic accumulation of LPO products, but also makes the antioxidative enzymes in patients with AMI [20], bad brain injury [18], ischemic heart disease [11], etc.

The researches focused on studying the influence of extremely high frequency therapy on patients with gastric and duodenal ulcer and effort angina that involves painless myocardial ischemia showed that electromagnetic waves of millimetric band restore the pro- and antioxidant balance in the body [26, 32].

It is proved that magnetic therapy in treating experimental erosive and ulcerative gastroduodenal lesions using the drugs that generate the vorticity pulsed magnetic field, activates the metal-dependent enzymic antioxidative system of the experimental animals [29].

SCENAR-therapy is one of the comparatively new non-drug therapies that act by influencing the development of the oxidative stress. SCENAR-therapy is the stimulation with complex-modulated pulses that are in shape like spike potentials of alive irritable systems and change their amplitude and frequency characteristics following the individual response of the body basing on the biofeedback and prevents the development of accommodation to SCENAR-stimulation [12, 13].

Recent researches showed the influence of SCENAR-therapy on the development of the oxidative stress in the experiment and clinics. At this the changes in the oxidative balance were studied in the patients with chronic disorders in acute conditions or rehabilitation, as well as in patients with acute pathology that require intensive therapy.

SCENAR-therapy effectiveness was evaluated at different stages of acute experimental pancreatitis in rats [31]. The research results prove that SCENAR-therapy normalizes the enzyme activity of cell antioxidative system when this activity in rats' erythrocytes had decreased and SCENAR-therapy has contributed its increase, but didn't inhibit the processes of compensatory activation of hepatocyte antioxidative system.

The influence of SCENAR-stimulation on free radical processes in the tissues and structure and functions of erythrocyte membranes in oxidative stress was also studied in the experiment with mature lab white rats that were exposed to hyperbaric oxygenation (HBO) and in clinics with ischemic heart disease patients [14]. The first research group of ischemic heart disease patients received common treatment, and the second research group received common treatment complemented with SCENAR-therapy. SCENAR-therapy was administered with SCENAR 97.4. Treatment course: 10 sessions following the common stimulation technique (3 pathways, 6 points).

Research results showed that SCENAR has evident antiradical effect by deintensifying rapid chemoluminescence flash by 25% and light sum by 33% in relation to the initial value, provides significant decrease of the LPO products in the blood plasma and erythrocytes, as well as increases the activity of the key antioxidative enzymes in superoxide dismutase and catalase providing the restoration of the antioxidant balance in erythrocytes.

So, it was shown that compared to other common drug therapies including SCENAR-therapy into the multiple therapy of ischemic heart disease provided significant restoration of the prooxidant-antioxidant balance, inhibition of freeradical oxidation in the blood, activation of enzymic antioxidants. Inhibition of oxidative stress had more evident clinical effect manifested as improvement of the general state, normalization of sleep, decrease or management of heart pain.

In the research focused on studying the effect of SCENAR-therapy, as well as its influence on the redox balance, in early postinfarction angina without fibrinolytic therapy participated patients 3-4 weeks after the myocardium infarction that were admitted for further treatment and rehabilitation in the cardiological therapeutic facility [25]. The research studied the effect on the patients that underwent common therapy of early postinfarction angina, as well as patients that received drug therapy complemented with 10 sessions of SCENAR-therapy. SCENAR-sessions were administered each 2-3 days. Research results showed that in common therapy patients after non-Q-wave myocardial infarction manifested further development of the oxidative stress accompanied by generation of free oxygen forms and accumulation of secondary LPO products. SCENAR-therapy in the multiple treatment provided decrease in generation of free oxygen forms, if compared to the initial values, significantly decreased the level of secondary LPO products accumulation - conjugated dienes (CD), malondialdehyde (MDA), schiff bases (SB).

Changes in the biochemical state of patients with early postinfarction angina that underwent SCENAR-therapy not only significantly decreased the rate of pain episodes, but also greatly increased the amount of patients that had no angina attacks in the end of the treatment.

SCENAR-therapy effectiveness was also studied on patients with relapse of duodenal ulcer [30]. Clinical observations and special tests were performed with the further comparative analysis in patients from several groups that received common therapy, as well as multiple therapy complemented with SCENAR-stimulation with SCENAR 97.4 and with SCENAR 97.1. Treatment course: 10 daily sessions, 30 minutes each, following the general stimulation technique. Most patients had initial high amount of MDA - 1.3 times higher than the norm in erythrocytes and 1.5 times higher than the norm in the blood plasma. 50% of patients manifested significant decrease of antioxidative system activity of the blood plasma, 66.7% had damaged antioxidative protection system of erythrocytes. SCENAR decreased the amount of MDA in the blood plasma and erythrocytes and increased the corresponding values of antioxidative system. The obtained results were proved in the further researches [21].

Chronic insomnia patients with irritable heart also participated in the research. They underwent multiple therapy complemented with SCENAR-therapy. Group I patients took Zopiklone

(Imovane) hypnotic agent for 10 days. Group II patients received SCENAR-therapy. Treatment course: 10 sessions with SCENAR 97.4, every other day, following the general methods. Group I patients showed the increase of the active oxygen metabolites and that triggered the LPO reactions and the amount of LPO products increased a bit. Catalase and ceruloplasmin activity increased inappropriately. On the background of significant increase of all subjective sleep characteristics and decrease of irritable heart clinical manifestations SCENAR provided the increase of superoxide dismutase activity and significant increase of catalase activity.

In conclusion it should be noted that all the abovementioned non-drug therapies prevail over the antioxidative drug therapies as they restore the redox balance triggering the natural universal mechanisms of sanogenesis – genetically determined system of any living being (human, animal, plant), which provides body vitality in the physical world (Kokosov A.N., 2009). It also becomes clear that physiotherapeutic methods are unique in their influence on the body through this regulation link.