

Radomska Szkoła Wyższa w Radomiu

MEDICAL INNOVATIVE TECHNOLOGIES

Edited by
Chukhraiev N., Vladimirov A., Zukow W.

SINGLET-OXYGEN THERAPY

Scientific and methodological materials

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Marushko Y., Samosyuk N., Tkalina A., Vladimirov A., Unichenko A.,
Zavorotnaya R., Zukow W.

Edited by: Chukhraiev N., Vladimirov A., Zukow W.

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This scientific and methodical publication presents a physico-chemical concept for the preparation and application of singlet-oxygen therapy by activating photochemically sensitized air or ingesting water after its barbituration with activated singlet oxygen. Also, the technology of therapy and examples of its use in the treatment of a number of pathological processes for the purpose of correcting the disturbances of free radical oxidation are described.

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INTRODUCTION

The presence of free radicals in living organisms is a natural phenomenon as the physiological processes take place with their active participation. However, due to certain violations of internal mechanisms of self-regulation the disharmony of free radical reactions occurs, which ultimately manifests itself as a disease. Free radicals damage proteins and cell membranes, it contributes to the emergence of many diseases, including arthritis, allergic diseases, etc.

Free radicals are defined as an atom or molecule that has one or more free electrons. At a course of oxidation-reduction biochemical reactions the free oxygen or OH radicals are produced.

There is a natural antioxidant protection in living biological systems that regulates the processes of free radical oxidation and eventually converts them into low-active compounds. In the treatment of diseases associated with the violation of free radical oxidation the antioxidants are used.

In 1996 swedish scientist Antony Van der Valk proposed singlet oxygen therapy as an alternative method of antioxidant protection, and the company PolyValk (Sweden) developed a special device named «Valcion» for inhalation therapy and water activation. Over the years of its application, the device has well proven itself in various clinics in Europe, America and CIS countries.

The oxygen, which is contained in the air, under the influence of hard ultraviolet radiation is converted into singlet oxygen in the activator of the «Valcion». The oxygen molecule O_2 lives for a limited time in a singlet state, after which it decays and recovers to its normal state. This process of singlet-triplet dipole transition is accompanied by the emission of an electromagnetic wave of the ultraviolet range, which activate a chain of biochemical and biophysical processes aimed at normalizing exchange-oxidative reactions in the body.

The results of the singlet oxygen practical application indicate that the frequency of asthma attacks in patients, in particular with bronchial asthma is significantly reduced under the influence of singlet oxygen.

There are statistically confirmed results of successful treatment of rheumatic patients using the proposed method (V.E. Orel).

In 1998, the Scientific Research Center «Medinter» (Kiev) performed the development, and since 2000 started serial production of devices for singlet-oxygen therapy - the «MIT-S» series. Generators

of hard ultraviolet radiation are used as a source of radiation for the formation of singlet oxygen in the apparatus.

In order to increase the singlet oxygen production efficiency, the principle of double magnetic processing of steam-water mixture is applied in the device MIT-S, (Patent of Ukraine No. 1395 «Apparatus for preparation of singlet-oxygen mixture», September 16, 2002, Bulletin No. 9, 2002; the Patent of Ukraine № 33892 «Apparatus for the preparation of a singlet-oxygen mixture», 10.07.2008, Patent of Russia No. 81644 «Apparatus for preparation of a singlet-oxygen mixture», 27.03.2009).

At the first stage the steam-water mixture undergoes the turbo-vortex magnetization. At the second stage, the activation of the steam-water mixture is carried out by hard ultraviolet radiation in a magnetic field. The proposed principle of steam-water mixture treatment contributes to the emergence of spin polarization of electron clouds, to energy stability and increase in the effectiveness of the therapeutic action of the singlet-oxygen mixture.

It was also found out that the treatment of a steam-water mixture with hard ultraviolet and quasilaser radiation in a magnetic field leads to the formation of not only an extremely active oxygen form – the singlet ($^1\text{O}_2$), but also nitrogen oxide (NO). The latter, as it became known, is a universal regulator of physiological and metabolic processes both in a single cell and in the body as a whole.

It is the nitric oxide produced in the body by the vascular endothelium (endothelium dependent relaxing factor) to which is given a special importance in the regulation of vascular tone, inflammation and immune response. NO has vasodilator, immunomodulatory, anti-inflammatory, and anti-atherogenic effect.

Therefore, singlet-oxygen therapy (SOT) can rightly be called singlet-oxygen-nitricoxide therapy (SONOT). However, in this work we have retained the term SOT as more well known and generally accepted.

Application of singlet oxygen is performed by inhalation or taking aqueous solutions enriched with singlet oxygen. A technique for structuring water and other liquids for the preparation of singlet-oxygen cocktails or foams has also been developed. The duration of one procedure can be from 1 to 9 minutes. The use of aqueous solutions should occur within 10 minutes after their preparation.

By analyzing the data of clinical observations and studies, it can be concluded that the method of antioxidant therapy using singlet oxygen

in the form of inhalations, cocktails and foams can be successfully used in pathological conditions associated with the violation of antioxidant protection.

The method is easy to use and does not require special training of maintenance personnel. It can be used both in complex treatment of a number of diseases, and independently for the purpose of prevention and recovery of the population. Singlet-oxygen therapy has a normalizing effect on the immune system, stabilizes aerobic metabolism and thereby improves the performance of all organs and systems without causing side effects.

Undoubtedly, the method of SOT will find wide application in various areas of clinical and rehabilitation medicine, and it already do «cramps» of many variants of inhalation therapy today. Simplicity of application, safety and high efficiency make the method of SOT popular among doctors and patients. It goes without saying that further research is needed to clarify the mechanism of SOT action, the peculiarities of its use for specific pathologies or functional disorders.

The method of SOT is a new method of therapy in the world practice and the task of every physician and researcher is to accumulate «generalize» facts, making them available to the broad medical community.

The presented manual can serve as a guide for the practical application and implementation of this accessible and yet unique method.

1. THEORETICAL BASIS FOR SINGLET-OXYGEN THERAPY APPLICATION

Singlet-oxygen therapy is a new method of oxygen therapy based on the use of singlet-oxygen mixtures (SOM).

Many medical institutions used singlet-oxygen therapy for the treatment of various diseases. There are reliable data on the effectiveness of this method in the treatment of chronic abstinence bronchitis, bronchial asthma (O.I. Voloshin, N.O. Splavskaya) and patients with rheumatism (V.E. Orel).

The use of singlet oxygen in the treatment of cardiac diseases normalizes the hemoglobin, erythrocyte and leukocyte count in the blood, and also improves the overall condition of patients, normalizes blood pressure, shortens the duration of angina attacks, positively influences the dynamics of ECG indicators (E.O. Gladchuk, G.V. Zhdanov).

The use SOT in patients with diabetes mellitus revealed positive changes in carbohydrate metabolism, as well as a decrease in clinical manifestations (polyuria, dyspepsia, paresthesia) (A.Y. Mandryka, V.I. Gavrilenko).

The activation of phagocytosis and a decrease in the autoimmune alertness of the organism have been proved at studying the effect of singlet oxygen on the immune status (V.V. Chopyak, A.M. Gavriluk).

There was a tendency towards normalization of respiratory enzymes, external respiration function, and blood pressure in the small circle of blood circulation significantly decreased when using SOT in the treatment of bronchial asthma (E.M. Neiko, R.M. Dumka).

The study of the singlet oxygen effect on the coagulating system of blood in patients with myocardial infarction showed a positive effect of this method on shortening the terms of the rehabilitation period (A.A. Vladimirov, V.D. Bugaev).

Treatment of patients in the postoperative period with the inclusion of singlet oxygen showed a positive effect of SOT on the biochemical indicators of blood (cholesterol level, Timol test) (P.I. Grinevich, N.A. Kocherga).

Immediate results of the treatment of patients with lung cancer using the SO-therapy indicate the stabilization of the tumor process.

As a result of the study, it was proved that this method enhances the phosphorylating respiration of mitochondria, which leads to the normalization of oxygen homeostasis (V.E. Orel, N.I. Dzyatkovskaya).

The formation of SOM is based on photochemical and photoenergetic sensitization of water vapor (aqueous solutions) by ultraviolet (UV) radiation. Conversion of steam-water mixture to SOM is carried out in the process of this mixture passing through a special activator, where it is exposed to UV radiation. Under the action of hard ultraviolet radiation, water oxygen is excited and the O₂ molecule is transformed into a singlet state. This state is characterized by the transition of the oxygen molecule electron clouds to higher levels. As a result, the kinetic energy, and, consequently, the amplitude of vibrational motions of intermolecular water bonds increases. In this case water acquires a unique property - a small-cluster state. The residence time in this state is short, and the oxygen molecule of water returns to its original state. The newly formed water has a structured state, which is similar in its properties to the intracellular state of water in biological structures. The additional application of the magnetic field contributes to the spin polarization of electron clouds, which makes the

water molecule more energy-intensive, and accordingly water – unique. This process of singlet-triplet dipole transition is accompanied by the release of electromagnetic energy quanta in the ultraviolet range, which constitute the energy-information basis of SOM.

The entry of SOM into the human body exerts an effect on the membrane-exchange processes and bioenergetic transformations within the cell, the result of which is the normalization of antioxidant functions.

Acquisition of SOM into the human body is carried out by inhalation, reception of activated water, aqueous solutions, cocktails and foams (Fig. 1).

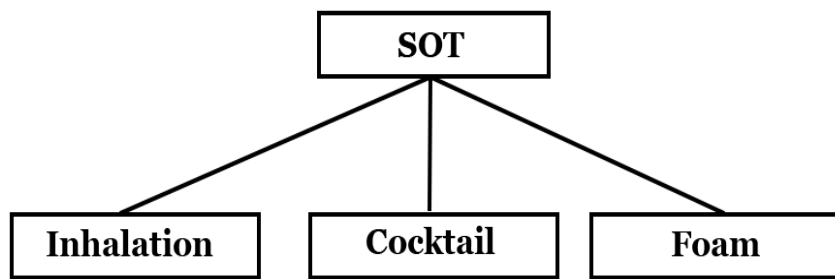


Fig. 1 The singlet-oxygen therapy options

The following basic biophysical and biochemical processes occur as a result of SOM application:

- activation of biochemical and biophysical reactions;
- stabilization of aerobic metabolism;
- normalization of blood pressure, biochemical parameters and antioxidant functions of the body;
- improvement of rheological properties of blood, coronary and cerebral circulation, tissue respiration;
- decreased tissue hypoxia and lactic acid level in muscles;
- restoration of ion permeability of cell membranes;
- stimulation of regenerative and reduction of inflammatory processes;
- body detoxification;
- inhibition of the tumor process;
- increase of body immunity.

In addition, SOT provides faster recovery of the body functional state after:

- heavy physical overloads or sports competitions;
- stress conditions;
- poisoning, including alcohol;
- extensive surgical interventions;
- injuries;
- overheating and UV burn.

SOT is well combined in a complex with medicament treatment, physiotherapy and sanatorium treatment.

1.1. Life-giving oxygen

The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself.

George Bernard Shaw

The basis of our body's life form three factors: air, water and food. Without air, a person can live no more than 3-5 minutes, after which irreversible processes occur, without water from 3 to 7 days, without food for 30 or more days.

So what do we breathe? The total pressure in the body, as well as in the atmosphere, is 760 mm Hg, the partial (partial) pressure is distributed as follows: nitrogen–79%, oxygen–21%, carbon dioxide–0.3%, argon is less than 1% and a small amount of other gases.

Table 1 shows the equilibrium balance in which the gases must be present in the body: a disturbance of this equilibrium is fraught with consequences.

Table 1 Gases proportion.

Gas	Atmosphere	Lungs	Arterial blood	Venous blood	Tissue
Nitrogen	79	79	79	79	79
Argon	1	1	1	1	1
Oxygen	21	13-14	10-12	4-4.4	4.5-5
Carbon dioxide	0,11- 0,3	6-7	6-6.5	6-7	6.5-7.5

Nitrogen. In the process of breathing its role is as follows. It is assimilated in the body by specific microorganisms (bacteria) located

in the tracheobronchial part of lungs and in the intestines. In the human and animals bodies nitrogen compounds can also decompose to molecular nitrogen and it can even be exhaled even more than inhaled. It turns out that we not only breathe nitrogen, but also feed on it, just not atmospheric, but interrelated, proteinic.

Argon is an inert gas. But the works on the development of life support systems for spacecraft has shown that this gas increases the resistance of the body at increased deficiency of oxygen (hypoxic hypoxia) with respect to nitrogen, both at normal and elevated pressure, as well as during compression and decompression.

The free molecular oxygen O_2 contained almost exclusively in the atmosphere and is the basis of all biochemical processes in the world. It acts both as a builder and as a destroyer. Oxidizing organic substances, oxygen supports breathing, and hence the life. Up to 20 m^3 of air passes through the respiratory organs of human during the day. This means that in a day one person consumes more than 4 m^3 of oxygen. For example, an average car for 1500 km of run uses the annual oxygen rate necessary for a person. Through the lungs, oxygen enters the bloodstream and is carried throughout the body, causing oxidation reactions in cells. These reactions occur with the release of energy, due to which the constant body temperature of warm-blooded animals is maintained and the vital activity of the organism is realized.

Passing through the lungs, blood is saturated with oxygen. In this case, a complex formation - hemoglobin - passes into oxyhemoglobin and, along with nutrients, is carried throughout the body. The blood becomes bright red. Having absorbed all the waste products of metabolism, the blood already resembles waste water and re-enters the lungs, where in the presence of large amount of oxygen, the decomposition products are burned, the excess carbon dioxide is removed.

The work of the body begins with its structural unit, the cell, where everything is necessary for life: the processing and consumption of food, the transformation of substances into energy, the allocation of waste substances. However, the process of obtaining energy and using it in a cell continues to be considered by modern science from the chemical laws point of view. The latter means that in a living cell there can not be quantum relationships proceeding at great speeds. At the same time, there is a lot of data showing that the processes of bio-oxidation in cell end with the formation of high-frequency and ultra-high-frequency EMF and ionized proton radiation, rather than the

formation of ATP. The cell is capable of even producing oxygen and energy due to free radical oxidation of saturated fatty acids. But it must receive an energetic excitement for this, which is provided by red blood cells.

In the modern ecological era, the circulation of oxygen is mainly associated with carbon and hydrogen. Thus, in addition to carbon (50-55%), oxygen (19-24%), hydrogen (6.5-7.5%), other elements (phosphorus, iron, sulfur, copper, etc. - almost half of Mendeleyev's periodical table) form the composition of proteins, and the normal functioning of cells depends on their electrolyte balance. Nevertheless oxygen and carbon dioxide still have huge importance in this system.

Carbon dioxide is the second after oxygen the most important critical regulator and substrate of life. Carbon dioxide stimulates breathing, promotes the expansion of blood vessels of the brain, heart, muscles and other organs, participates in maintaining the necessary acidity of blood, affects the intensity of gas exchange itself, increases the reserve capabilities of the body and the immune system. With a shortage of carbon dioxide in the body, oxygen forms a strong bond with the hemoglobin that prevents oxygen release to the tissues. Only 25% of oxygen enters the cells, the rest returns to the lungs through the veins.

With a constant physiological concentration of carbon dioxide in the cells, it promotes the expansion of capillaries. At the same time more oxygen enters the intercellular space and then diffusing into cells, each of which has its own genetic code, where the entire program of its activities and working functions are programmed. If we create normal conditions for supplying the cell with oxygen, water, food, then it will work properly all the time laid by nature. The fact is that breathing should be less frequent and shallow and on exhalation and inhalation it is necessary to do more time delay, thereby contributing to the maintenance of carbon dioxide at the physiological level in the lungs, ensuring the removal of spasm of capillaries and normalization of metabolic processes in tissues.

Oxygen is the most necessary and desirable element in our body. Oxygen baths, pressure chambers, inhalations, oxygen cushions, cocktails and foams have long been used in medical practice for the treatment of various diseases. If there is not enough oxygen in the blood, the brain work is disrupted, the heart rate increases, the number of red blood cells in the blood increases, the immunity decreases, the aging process of the organism accelerates significantly, the risk of

respiratory diseases increases, the threat of a stroke or myocardial infarction appears, and the vasospasms contribute to the development of hypertension.

Oxygen therapy helps to solve all these problems and in its physical properties and physiological action refers to the physiotherapy method that uses a modified or special air environment.

Oxygen therapy improves functional state of the cardiovascular and nervous system, improves well-being and sleep, has a vagotropic (protective) effect, improves protein and lipid metabolism. The latter is indicated by a decrease of pyruvic and lactic acids level in the blood, lactate in the urine. Improves the oxidative ability of the liver. Therefore, oxygen therapy is used for acute toxic-chemical lesions of the lungs, chronic diseases of the cardiovascular system (atherosclerosis, coronary heart disease, hypertension, rheumatism, etc.), diabetes, digestive and hepatobiliary diseases, toxicosis of pregnancy, endocrine diseases, some blood diseases, infectious diseases, ascaridosis, obesity, etc.

There are inhalation and non-inhalation (intragastric, rectal, subcutaneous, etc.) methods of oxygen therapy that are used in practice.

Intragastric oxygen therapy is a method of affecting oxidation-reduction processes in the body by introducing oxygen cocktails, oxygen-activated water and oxygen foams into the stomach (intake of per os).

But we must also remember an important circumstance: an overdose of oxygen threatens the danger of peroxide compounds formation, for excess oxygen is an increase in the number of free radicals. The lungs should contain as much oxygen as it is in the atmosphere at an altitude of 3000 m above sea level. This is the optimal value, the constant excess of which leads to pathology.

1.2. Singlet oxygen

The main physiological processes in normal and pathological conditions in the human body occur with the participation of free radicals, as a result of oxidation-reduction reactions of the necessary biological products of normal cellular metabolism. In the body, free radical oxidation processes are regulated by an antioxidant system.

Nowadays due to endoecological problems of man (contamination of the body with heavy metals, radionuclides, smoking, unbalanced nutrition, electromagnetic fields, excessive physical and emotional

loads, etc.), the work of the antioxidant system is disrupted, and the reactivity of free radicals that damage cells or lead to their death increases.

Almost all energy our body receives from the oxidation reaction of proteins, fats and carbohydrates, taking place with the participation of oxygen. It is said that a person receives energy as a result of «burning» food. In order for O_2 to be used effectively, it must be activated. There are a number of mechanisms in the body that provide this. But they, in turn, must be maintained in the active state, which is performed by reactive oxygen species (ROS) - ionized oxygen (superoxide radical); singlet oxygen 1O_2 and hydrogen peroxide (H_2O_2), free-radical particles containing oxygen residues. If the ROS in the body is not enough, then the proprietary oxygen activation systems decay, and the efficiency of its use sharply reduces, the toxic products of incomplete oxidation (slags) begin to accumulate, which can be eliminated by increasing the oxidative activity of oxygen.

A person gets an ROS with air, water and food. If the body has violated the natural regulation of oxidative processes, then unoxidized products accumulate in unacceptable amounts. This happens as a result of infectious diseases and other diseases affecting the immune system, or with prolonged consumption of water and food poor in active oxygen. Then there are not enough reserves of O_2 's own activation systems, those levels of active oxygen that is available in ordinary fresh air and ordinary drinking water are not enough. In this case, consumption of water and air with increased oxygen activity is required.

To date, this is precisely the Singlet-Oxygen Therapy as the method of stimulating the production of ROS, in which an important role belongs to one of the forms of active oxygen – the singlet oxygen, which, unlike ordinary molecular oxygen, readily enters chemical oxidation-reduction reactions, and such reactions can also proceed in water with the emission of not only heat, but also the light quanta, which together with 1O_2 , O_2 , in H_2O vapors forms the basis of the singlet-oxygen mixture, as a therapeutic factor of SOT.

Although singlet oxygen can be formed in some dark enzymatic processes, the main way of its production is due to light reactions, which are mediated by pigments-photosensitizers.

The diagram of the formation of 1O_2 is as follows (Fig. 2). Absorbing the energy quantum ($h\nu$), the pigment-photosensitizer transforms into singlet ($1p$) and then into triplet ($3p$) excited states. Pigment molecules in both excited states colliding with the O_2

molecule transfer their energy to it, as a result of which the active singlet molecular oxygen is formed. Such toxicity of pigments, which is manifested in light and in the presence of oxygen, is called the photodynamic action.

Fig. 2 The scheme of the oxygen molecule electronic structure formation in the singlet state

For the first time singlet oxygen was detected in 1924, and then it was determined as a more active form of oxygen. Since O_2 is omnipresent and effectively «extinguishes» electronic excited states, the molecule of more active singlet oxygen undoubtedly plays an important role in the diverse processes of the biosphere from purely photophysical ones in the earth's atmosphere, to the inclusion in the most important photobiological reactions of living organisms and plants.

In most cases, destructive reactions are associated with 1O_2 , for the neutralization of which in living cells there are genetically fixed defense systems, the effective work of which is indispensable for the survival and normal functioning of the body as a whole. On the other hand, artificial stimulation of 1O_2 generation processes is used in photodynamic therapy of cancer and other diseases.

Particular importance of the ROS is to fight against infections, foreign cells and proteins. Everything begins with the ancient mechanism of fighting «strangers» - phagocytosis, when the captured stranger agent (microorganism, atypical cell, etc.) is exposed to bactericidal mechanisms.

With the onset of phagocytosis, a sharp activation of the hexosomonophosphate shunt generates NADPH. NADPH is used to restore molecular oxygen associated with a unique membrane cytochrome (cyt b-245), which causes a rapid consumption of oxygen. As a result, a superoxide anion, hydrogen peroxide, singlet oxygen and

hydroxyl radicals are formed - all of which serve as powerful bactericidal agents. Moreover, the combination of peroxide, myeloperoxidase and halogen ions creates a powerful halogenation system capable of causing the death of both bacteria and viruses.

It is important that the oxygen-dependent mechanisms of this struggle serve as the basis for subsequent oxygen-dependent mechanisms (Table 2), which can act under anaerobic conditions. However, without the first phase (oxygen-dependent), the second (oxygen-independent) is of little effect in the fight against «strangers».

Table 2. Oxygen-independent mechanisms

Oxygen-independent mechanisms	
Cationic proteins (including cathepsin G)	Damage of microorganisms membranes
Lysozyme	Cleavage of the bacterial cell wall mucopeptides
Lactoferrin	Deprivation of iron of proliferating bacteria
Proteolytic and hydrolytic enzymes	Digestion of killed microorganisms

With dismutation of peroxide (Table 3), the hydrogen ions are consumed and the pH slightly increases, this creates optimal conditions for the functioning of the cationic proteins family. These proteins destroy the bacterial membrane both due to the proteinase effect (neutral proteinase, cathepsin G), and by direct attachment to the surface of the microorganism. Low pH, lysozyme and lactoferrin are oxygen-dependent bactericidal and bacteriostatic factors. Eventually, the killed microorganisms are cleaved by hydrolytic enzymes, and the degradation products are released from the cell.

Currently, the considerable experimental material is accumulated, indicating that ROS and water under normal physiological conditions are the initiators and regulators, key players of free-radical metabolism. ROS, including $^1\text{O}_2$, interact very strongly with water protons and at low concentrations form «defects» in the quasilattice of water, migrating throughout its structure and leading to the appearance in the aquatic environment of long-lived nonequilibrium states-clusters.

The lifetime of ROS in water when generated by high-energy pulsed methods, decomposing H_2O molecules, usually does not exceed hundreds of milliseconds, however, at relatively low doses of ROS, long-living nonequilibrium states of the aqueous medium and aqueous solutions are often observed. It is assumed that there is always

a certain amount of ROS in water formed by the decomposition of water molecules under the influence of radioactive background of the Earth (in 1 cm³ of water or living tissue per second, according to some estimates ~ 10⁴ ionized states are formed). A number of other factors can serve as a source of small quantities of the ROS. For example, the action of low power ultrasound leads to the generation of ROS and nitrogen oxides from air molecules dissolved in water. Often observed biological effect of low-intensity physical factors (electromagnetic waves, electric, magnetic, acoustic, etc. fields) is apparently due to their influence on the formation and recombination of ROS in the aquatic environment.

1.3 SOT as a healing factor

The formation of physiologically active SOM occurs by photochemical sensitization of air and steam-water mixture in the device's activator to obtain singlet oxygen – highly reactive substance with a short decay period. Due to the transformation of singlet oxygen, secondary long-lived biologically active components are formed, that create the therapeutic basis for singlet-oxygen therapy. Obtaining SOM in the MIT-C series can be explained according to the scheme shown in figure 3.

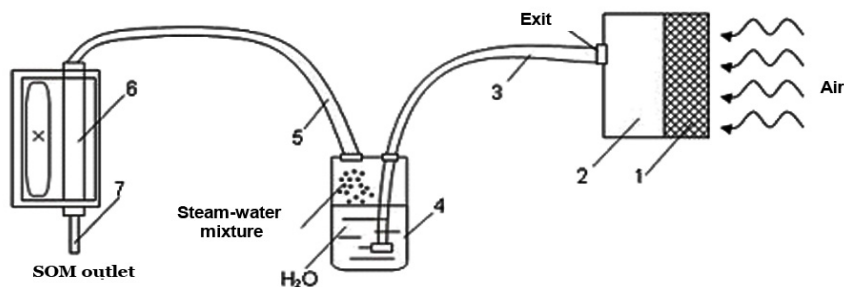


Fig.3. The scheme of obtaining SOM in devices «MIT-S», where: 1 - air filter; 2 - the compressor; 3,5,7 - silicone connecting hoses; 4 - a flask-reactor (Bobrov's device); 6 - activator; 7 - the output hose.

With the help of compressor **2**, air is supplied to the air filter **1** and enters the bottom of the reaction flask **4** where water is poured (distilled, mineral gas-free or homeopathic aqueous solution). At the outlet of the hose **3** a sprayer is installed, which ensures the high-quality barbiturating of water with air, the result of which is the formation of

steam-water mixture. The heavy fractions of moistened air settle on the water surface, and the light along the connecting silicone hose **5** enters the activator **6**, where the SOM is formed. The scheme of the MIT-S activator is shown on figure 4.

*Fig.4. Scheme of «MIT-S» apparatus activator,
where: 1-mercury lamp; 2-quartz tubes; 3-light-emitting diodes;
4-permanent magnet; 5-protective screen housing.*

The steam-water mixture passing through the quartz tubes **2** from the inlet to the outlet is exposed to the electromagnetic radiation of the UV-range created by the mercury lamp **1**, which results in the transition of atoms and molecules to excited singlet states characterized by the transition of electrons to higher energy levels, the kinetic energy, and, consequently, the amplitude of vibrational motions of intermolecular and hydrogen bonds increases. In this case, the water molecule acquires a unique property – a small-cluster state. The residence time in this state is short ($\sim 10^{-6}$ s), and the water oxygen molecule returns to its initial state with the formation of clusters $(H_2O)_n$. The newly formed water has a structured state and is similar in properties to that of water in biological structures. The additional application of a magnetic field created by a permanent magnet **4** contributes to spin polarization of electron clouds, which makes the water molecule more energy-intensive, and water, respectively, active. This process of the singlet-triplet dipole transition is accompanied by the release of energy quanta in the UV range, which constitute the energy-informational basis of the SOM.

To increase the time of oxygen existing in the singlet state, there is additionally used in the activator the impact on the steam-water mixture by the pulsed emission of the optical (red) wavelength range created by the LEDs **3** located along the entire length of the quartz tubes **2** of the activator that structurally realized in the protective metal shield-body **5**.

Thus, the activator of apparatus MIT-S uses the physical method of obtaining singlet oxygen from atmospheric air and steam-water mixture, when UV radiation is applied to them. Although the efficiency of such a process is not more than 10% O_2 , but does not require additional use of photosensitizers pigments.

The following methods are used to detect singlet oxygen:

- Purifiers that can inhibit reactions that depend on O_2 . For example, isids act as physical cleaners of O_2 , reactions with the formation of reactive azide radicals:

$$N+O_2N+O_2;$$
- The «heavy» water D_2O isotope can be used to detect 1O_2 by measuring the singlet oxygen lifetime, which is 10 times longer in «heavy» water than in H_2O . Therefore, if the reaction in the appropriate solvent is dependent on O_2 , then in D_2O the reaction must be much more active;
- Since 1O_2 returns to the initial state, some part of the energy is radiated in the form of light. This radiation corresponds to the infrared spectrum with the wavelength of 1268 nm.

2. OPERATIONAL AND TECHNOLOGY GUIDANCE. METHODS OF SOT APPLICATION. INDICATIONS AND CONTRAINDICATIONS.

2.1. General method of SOT using singlet oxygen inhalations and activated water

The following method of SOT is clinically well-tried on more than 100,000 patients of various profiles at different resorts and medical institutions.

This method is most universal, but the doctor can prescribe another version of it, depending on the functional state of the patient's organs and systems, the stage of the process, individual patient's biorhythms, etc. Such options for SOT are also given in this manual.

Technology of the metod

- The SOT session consists of SOM inhalations for 5-7 minutes and the subsequent use of activated water in amount of 150-200 ml.
- Optimal is to use of the MIT-C device for one patient. In this case CHANNEL I is used for inhalation, and CHANNEL II is used to activate water (aqueous solutions).
- In medical institutions (including inpatient facilities), adults with moderate to severe forms of disease are treated with SOT twice a day with an interval between sessions of at least 6 hours (Mode I) (Table 4). Patients with mild forms of the disease, without exacerbation should have SOT once a day (mode II) (Table 5).
- In clinics of general practice, sanatoriums, boarding houses, rehabilitation centers, sports and beauty centers for the treatment of patients with mild forms of the disease or for preventive measures the SOT is used once a day (mode II).
- For prevention of a possible disease exacerbation along with the singlet-oxygen therapy (possible exacerbations can occur after 3-5 daily procedures), the patient should take vitamins A, E, C, B (A-Evit, etc.) during the entire course of treatment. Sessions are performed each other day, possibly as short courses (not more than 5 sessions per course).
- Detoxification therapy using SOM should be accompanied by the use of sufficient amounts of water (2-3 liters per day). If at any stage of SOM usage the patient feels the increased symptoms of detoxification (in 0.7-1.2% of patients in the first 2-5 days can

arise headache, insomnia, runny nose, cough, rumbling in the abdomen, rashes, etc.), it is recommended to reduce the duration of each next inhalation session by 1-2 min and the amount of activated water for consumption by 50 ml until the above symptoms disappear.

Table 4.
Method of SOT (mode I) for patients with moderate and severe form of the disease.

Days of treatment	Sessions	the amount of SOM for taking per os, ml	Duration of inhalation, min
1	first	100	3
	second	100	3
2	first	100	5
	second	100	5
3	first	100	5
	second	100	5
4	first	150	5
	second	150	5
5	first	150	7
	second	150	7
6	first	150	9
	second	150	9
7	first	200	9
	second	200	9

Table 5.
Method of SOT (mode II) for patients with light form of a disease.

Days of treatment	the amount of SOM for taking per os, ml	Duration of inhalation, min
1-3	150	7
4 and the next	200	9

Possible combination with other procedures:

- with all variants of device physiotherapy;
- drinking treatment with mineral waters (time interval of 1.5-2 hours);
- exercise therapy, massage, manual and kinesitherapy;

- medical treatment (the procedure of SOT to be performed not earlier than an hour after taking medication per os); the same is applied to physiotherapy.

Mistakes in physician prescribing:

- prescribes the SOT without taking into account the patient's biological rhythms; uses in treatment only activated distilled water, whereas it is possible to prescribe (according to indications) activated herbal tea, decoctions, infusions, foams, etc.; does not combine SOT with other methods of physiotherapy and necessary medication;
- does not prescribe antioxidants (prevention of exacerbation) during the course of SOT;
- the age of the patient and, correspondingly, the dosage of SOT is not taken into account.

Possible nurse mistakes:

- releases procedures without an accurate duration;
- does not monitor the timely use of SCS (activated liquids) immediately after preparation.

2.2. Features of singlet-oxygen therapy in pediatrics

The effectiveness of SOT in pediatric practice has been confirmed by many studies and by various treatment facilities. Particularly significant results were obtained in the treatment of respiratory diseases, chronic diseases of nasopharynx, including chronic tonsillitis, sinusitis, gastrointestinal tract diseases (dyspepsia, dyskinesia). SOT can also give positive results in treatment of helminthic invasion, acute respiratory diseases. Particular importance of this therapy is proved in children health improving, which is used with other physical factors (hydrolaser douche, magnetolaser therapy, aromatherapy), physiotherapy exercises.

As in the treatment of adults, SOT in pediatrics can also be combined with other methods of physiotherapy and medicinal treatment. In cases of other options for inhalation therapy, the procedure of SOM inhalation is recommended to alternate (on alternate days). The dosage of SOM for one procedures depends on the age of the child. If in adults the optimal oral intake dose is 200 ml of sinflet oxygen mixture, and the duration of inhalation is 9-10 minutes, then in children they are regulated as follows.

Table 6.
Recommended doses of SOM for oral administration
and duration of inhalation in pediatric practice

Age of a child, years	Dose relative to adults	The amount of SOM for oral administration, ml	The inhalation duration,	Comment
1-2	1/7	28 - 30	85-90 s (up to 1.5 min)	For children under 1 year of age, SOT is performed only for special indications. Do not perform more than two procedures per day. The course of treatment is 10 to 15 procedures that can be performed every other day or in short cycles of 5 procedures with a 2-day break.
2-3	1/6	33 - 35	90-100 s (up to 1.6 min)	
3-4	1/5	40 - 45	100-120 s (up to 2 min)	
4-6	1/4	50 - 55	120-150 s (up to 2.5 min)	
6-8	1/3	60 - 65	150-200 s (up to 3.3 min)	
8-10	1/2	100 - 110	200-300 s (up to 5 min)	
10-14	3/4	145 - 150	300-450 s (up to 7.5 minutes)	
14-18	3/4 or adult dose	150 - 200	450-600 s (up to 10 min)	

2.3. Some features of singlet-oxygen therapy by the method of inhalation

Inhalation therapy is a method of physiotherapy, which affects the respiratory tract, lungs and the whole body by inhalation of sea, mountain, steppe, forest air, as well as the introduction of medicinal substances in the form of aerosols, vapors or gases into the respiratory tract for medical and preventive purposes.

Inhalation therapy is performed with aerosols, which are the smallest particles of solids or liquids suspended in a gaseous medium.

Aerosols are classified into dust, fumes and fogs, depending on the method of formation. Dusts are aerosols of solids, fumes are aerosols consisting of solid particles obtained by condensation. Mists are aerosols with liquid particles, obtained both as a result of dispersion and as a result of condensation.

At SOT a singlet-oxygen mixture is used, which is a kind of fog, that in addition to singlet oxygen ($^1\text{O}_2$) contains water vapor, nitric

oxide (NO) and air. Inhalation of SOM refers to the so-called wet inhalation with the formation of mainly small-droplet (from 100 to 250 microns) and in a less amount of large-droplet (from 250 to 400 microns) particles. The most important property of «foggy aerosols» is the ability of particles to persist in a suspended state for a long time. The universal mechanism of aerosols interaction with the airways mucosa cells is their active transport by the cilia of the ciliated epithelium and the absorption on the cells membranes of the mucous membrane and submucosal layer.

The SOM inhalation therapy for diseases of the respiratory system.

In some cases, when this type of treatment is preferable, it is necessary to pay attention to the positive mood of the patient and to obtain his consent to the performance of inhalations. It should be noted that taking tablets is much easier and more habitual for most people (an adequate explanation is necessary).

In obstructive pulmonary disease bronchodilators should be used firstly to relieve spasm of bronchial tubes and thinning sputum (mucolytics). To increase the penetrating ability of aerosols, medications that improve bronchial patency (bronchodilators) should be taken prior to inhalation, but do not rinse the pharynx with solutions of potassium permanganate, hydrogen peroxide and boric acid.

The possibility of conscious control of the respiratory act allows patients to actively intervene in the pace, intensity and duration of inhalations. It is necessary to instruct the patient on the method of optimal breathing and perform a preliminary complex of respiratory gymnastics and recommendations for the prevention of respiratory failure.

When determining the type of respiration of a patient, it is necessary to take into account the type of the bronchopulmonary tract patency violations and to strive to reduce bronchopulmonary ventilation expenditure. The predominance of restrictive breathing disorders makes frequent and shallow breathing more beneficial. On the contrary, in obstructive disorders, energy expenditure is minimal with rare and deep breathing.

For optimal distribution of aerosol particles in the tracheobronchial tree, the proper breathing technique is important. Use a mouthpiece or nebulizer for getting the aerosol particles

into the bronchi and alveoli and take a slow and deep breath, then hold your breath for 5 seconds and then quickly exhale (Figure 5). (G.N. Ponomarenko et al., 1998).

Fig.5. The curve of the breathing cycle during inhalation

Repeated deep breathing during inhalation can lead to hyperventilation syndrome and, accordingly, to unpleasant sensations during procedures (dizziness, nausea).

In cases of the pharynx and trachea diseases, aerosols are inhaled through the mouth. It is more preferable to use a mouthpiece than an inhalation mask. Only in cases where the mouthpiece can not be used (for example, in persons unconscious, newborns and small children), a mask should be used. In this case, it is desirable to exclude breath through the nose (for example, put tampons with cotton wool in the nasal passages or clothe the clamp).

In cases of nose and/or paranasal sinuses diseases, inhalation is carried out through the nose. The nose is an effective aerosol filter that captures particles of an active substance larger than 1 μm (Heyder J. et al., 1980). A high degree of aerosol deposition in the nose is also due to the turbulence of the aerosol in the nasal turbinates. In this case, the aerosol falls only in the front part of the nose. This is enough to open the anastomoses of the paranasal sinuses.

In diseases of the nasopharynx and larynx, regular inhale and exhale, of a moderate depth, is recommended - practically normal breathing.

In the pathology of bronchi and lung tissue most researchers recommend a slow deep inhale during inhalations (optimally - the level of vital capacity of the lungs) with a delay of 5 to 10 seconds for respiration. However, some authors believe that submaximal inhalation is sufficient for a full-fledged inhalation, and holding the breath is not important, decisive importance is attached to slow inhalation (Pederson, 1989).

When carrying out inhalations, the following rules must be observed (G.N. Ponomarenko et al., 1998):

- inhalation should not be taken immediately after a meal or physical strain, as diaphragm and thoracic excursions are difficult; the procedure should be performed 1-1.5 hours after ingestion or exercise;
- during inhalation it is necessary to sit in a comfortable pose, calmly, without being distracted by conversation or reading. In this case, clothing should not impede breathing and constrain the patient's neck; it should be taken into account that a strong inclination of the trunk forward during the procedure makes it difficult to breathe;
- in case of nose, paranasal sinuses and nasopharynx diseases, inhalation and exhalation should be done through the nose, breathing calmly, without tension; during exhalation through the nose, a part of the air with aerosols of the drug substance penetrates into the paranasal sinuses;
- for diseases of the oral cavity, pharynx, larynx, trachea, bronchi, it is necessary to breathe deeply and evenly; after a deep inhalation, hold your breath for 2 seconds, then make a full exhalation through the nose; frequent deep breathing can cause dizziness, so it is necessary to interrupt the inhalation periodically for a short time;
- after inhalation, a rest is required for 15-20 min, and in the cold season - up to 30-40 min; after inhalation, one can not talk loudly, sing or smoke for an hour; should also avoid transitions from a warm room to a cold;
- it is not recommended to prescribe the inhalation therapy and aeroionotherapy in one day. It is not recommended to use oil inhalation before wet or steam inhalation.

2.4. Influence of SOT on the state of the broncho-pulmonary system in bronchial asthma

When treating diseases of the respiratory system with the inclusion of SOT into the treatment complex, it is necessary, if possible, to take into account the biorhythmological features of the respiratory system functioning. Thus, in the treatment of bronchial asthma, bronchial obstructive syndrome, including smokers, an inhaled session of the SOT should be performed in the morning, immediately after the

patient woke up (this may be 4, 5, 6, or 7 hours). Technically, this is not difficult - the procedure is performed by the nurse on duty. The second procedure of inhalation SOT should be carried out at 15 to 17 hours. If necessary, the the procedure can be performed before bedtime (22-23 hours).

It is now shown that the use of SOT in combination with other methods in bronchial asthma (BA) contributes to:

- decrease in the number of mast cells, macrophages, T-lymphocytes, eosinophils in the bronchial epithelium and submucosal layer of the bronchi;
- restoration of the bronchial epithelium;
- reverse development of goblet-cell metaplasia;
- reducing the sensitivity of the airways to histamine, allergens, physical activity, cold air and other triggers;
- reduction of structural changes in the bronchial wall;
- reduction of bronchial mucus hypersecretion;
- decreased vascular permeability and edema of bronchial walls.

This reduces the severity of clinical symptoms of asthma, improves bronchial patency, prevents the development of irreversible changes in the airways. Especially it should be noted that inhalational SOT prevents the development of oropharyngeal candidiasis and dysphonia in patients with long-term inhalation of antibiotics, hormones, etc.

2.5. Effect of singlet-oxygen therapy on biophysical marks of deformability and osmotic resistance of erythrocytes in patients with chronic obstructive pulmonary disease

Studies of recent years have shown that free radicals (FR) play a significant role in the pathogenesis of many diseases (bronchial asthma, pneumonia, lung cancer, etc.). The leading positions are occupied by FR in the development of chronic obstructive pulmonary disease (COPD) and diabetes mellitus.

Reactive forms of oxygen (ROS) (hydrogen peroxide, hypochlorite, superoxide radical and hydroxyl) are formed due to the consecutive addition of electrons to molecular O₂ and take part in most physiological processes of the human body. They ensure the continuity of homeostasis, oxidation and detoxification of exo-and endogenous compounds, have bactericidal properties and affect immunity.

Antioxidant protection system controls the intensity of free radical reactions in the human body. Normally, the oxidant-antioxidant system maintains equilibrium. Violation of this balance in favor of enhanced generation of oxidants leads to the development of so-called «oxidative stress,» which is manifested by excessive and prolonged formation of a large amount of ROS and the development of relative insufficiency in the antioxidant defense system.

Violation of the stationarity of free radical reactions is a universal, nonspecific mechanism of pathogenesis, which underlies the development of a diverse pathology. In principle, any organs and tissues can suffer from oxidative damage. The lungs are most sensitive in this respect, since they contain physiologically the enhanced flow of free radical processes, in addition they directly contact with molecular oxygen, the initiator of oxidation, as well as with oxidants contained in atmospheric air (oxidants of tobacco smoke, nitrogen dioxide, sulfur, dust, microorganisms and many others).

One of the adverse effects of «oxidative stress» in COPD is a violation of the rheological properties of blood due to negative changes in the erythrocyte link, since it is the most sensitive to the intensification of free radical oxidation (FRO) processes. The direct and indirect destructive effect of ROS on the constituent elements of erythrocyte membranes leads to a decrease in their fluidity and deformation capacity, which is one of the defining characteristics of the oxygen-binding properties of blood and enables it to participate in the regulation of oxidative-pro-oxidant equilibrium. Changes in biophysical parameters of deformability and osmotic resistance of erythrocytes in COPD need further study with a view to their possible use as highly sensitive indicators of the activity of free radical processes and the evaluation of the effect of antioxidant therapy.

To date, the issue of introduction of new non-medicinal methods of antioxidant therapy in chronic obstructive pulmonary disease and diabetes mellitus is urgent, since even with the recommended treatment patients develop intensification of free radical oxidation processes with deterioration of the rheological properties of blood.

SOT in complex treatment stimulates body's own antioxidant system and allows unloading of its most strained areas.

The main goal of the work was to study the changes that occur in the biophysical parameters of the erythrocyte deformation capacity as integral indicators of the oxygen-binding properties of blood in chronic obstructive pulmonary disease in the period of exacerbation and

remission (provided adequate basic treatment). The effect of singlet-oxygen therapy on the stabilization of the above listed parameters was evaluated. On the basis of the results obtained, an optimal scheme of SOM use was developed for COPD of moderate severity in hospital settings.

Materials and methods

60 patients with COPD of the 2nd degree of severity took part in the study during exacerbation and during the period of remission. The study plan included screening visit I and treatment periods (2-4 visits) for two months after inpatient treatment. The work was carried out on the basis of pulmonology and evidence-based medicine at the Institute of Phthisiology and Pulmonology of the AMS of Ukraine. The definition of severity and the treatment plan was carried out according to WHO recommendations.

The first group consisted of 30 people (16 women and 14 men, mean age 56.6 ± 2.2 years), in the second group there were 30 persons (14 women and 16 men, age 59.4 ± 1.8 years) who received the singlet-oxygen therapy in addition, performed on the apparatus MIT-S manufactured by «MEDINTEH» LLC, Moscow, Russia. The course duration was 14 days, when patients received SOM per os and in the form of inhalation. The SOT regime is presented in the Table 7. The control group consisted of 13 healthy people (9 women, 4 men, age 52.1 ± 1.7 years).

Table 7. The singlet-oxygen therapy regime in treatment the COPD of moderate severity

Day of treatment	Morning inhalation duration, min	Evening inhalation duration, min	The amount of SOM for intake, ml
1	7	7	100
2-4	10	10	100
5-7	15	15	150
8-10	15	15	200
11-14	10	10	100

The following parameters were evaluated during the study: the degree of erythrocyte deformation, the relative charge of the membrane (RCM) and the relative gradient membrane potential of the erythrocytes (RGPEM), the crystal-optical characteristics of blood

serum, the total number of erythrocytes $\cdot 10^9/L$, hemoglobin (Hb (g/L) content of hemoglobin, saturated with O_2 ($Sa_2, \%$).

A study of the relative gradient membrane potential of erythrocytes was carried out with the determination of the pH of the blood solution in an unbuffered 0.9% physiological NaCl solution and in a distillate using an «OP-264/1» ionometer (Hungary). The relative charge of erythrocytes was determined by means of mathematical calculations. The SaO_2 was measured with the pulse oximeter UTAS OXI 200. The degree of red blood cells deformation and crystal-optical properties of blood serum were evaluated using the method of marginal dehydration of biological fluids with electron microscope «NU 2» of «VEB Carl Zeiss» company with MP 60 photosystem. The presence concomitant pathology in a state of remission was taken into account.

The crystal-optical parameters of blood serum were assessed on a scale (Shabalin V.N., Sumatokhina S.N.).

Serum Crystallization Scale:

0 - basic morphotype (filamentary structures, medium and large spherulites);

1 - mixed structure, which includes such subtypes:

a) fan-shaped;

b) with secondary fragments;

c) needle-like;

2 - «vitreous» structure (amorphization), the appearance of structures of the «bundle» type.

Degree of erythrocytes deformation was assessed on a scale (Kurik M.V.):

The evaluation scale of the degree of erythrocytes deformation:

0 - there is no deformation,

1 - 10-29% of erythrocytes are deformed,

2 - 30-69% of erythrocytes are deformed,

3 - 70% and more erythrocytes are deformed.

Parameters were determined prior to treatment, on the 14th day of therapy, and 2 months after exacerbation.

Statistical processing of the received data was carried out with the help of licensed software products that are included in the software package Microsoft Office Professional 2000, on a personal computer IBM Celeron in the Excel program using the t-test of the Student.

Results and discussion

In the first group of patients the relative gradient membrane potential before the start of treatment was higher than in healthy ones (0.397 ± 0.021 bp), the relative charge of erythrocytes was practically lost, almost disappeared (0.052 ± 0.009 μ V), the deformation degree of these cells was $3 \pm 0,0$ (appearance of stomatocytes).

Blood serum showed signs of hypoxic anisotropy ($2 \pm 0,0$). All changes in studied parameters significantly differed from those of the healthy group ($p < 0.001$). Patients of II Group also had an increase in RGPEM (0.381 ± 0.023), a loss of RCEM (0.055 ± 0.009), a degree of deformed forms of erythrocytes was (2.9 ± 0.0), hypoxic anisotropy of blood serum increased ($2 \pm 0,0$). These changes were significantly worse compared to the healthy group ($p < 0.001$).

It can be seen from the above results that when the COPD exacerbates, the significant disturbances in the deformability and osmotic resistance of erythrocytes occur due to the destruction of erythrocyte membranes with their loss of charge, the growth of irreversibly deformed forms takes place (transformation into a jagged spherocyte) and the development of hypoxic anisotropy of blood serum.

The presence of concomitant pathology in the phase of remission did not affect the indicators considered. All the data compared with the healthy group are presented in Table 8.

The index of SaO_2 in the group of patients of the first and second groups was significantly lower than in the patients of the control group. The total number of erythrocytes, blood Hb in all groups was within the age limit.

During the monitoring of the control healthy group, the significant changes in the estimated parameters (relative gradient membrane potential and relative charge of the erythrocyte membranes) on 14 day and after 2 months were not observed.

Both groups experienced a positive trend at 14 day during the treatment. RGPEM of the II group of patients decreased (0.287 ± 0.019) while RCEM increased (0.102 ± 0.007 v.o.), the degree of erythrocyte deformation (2.4 ± 0.1) and hypoxic anisotropy of blood serum (1.8 ± 0.1) became lower, nevertheless a significant difference remained in the parameters compared with the healthy group ($p < 0.001$), there were no significant changes in the estimated parameters, compared with the beginning of treatment.

Table 8.
The main parameters of blood in the groups
before the start of treatment ($M \pm m$)

Indicators	1	2	3
	I Group (n=30)	II Group (n=30)	Healthy Group (n=13)
RCEM	$0,397 \pm 0,021 \#$	$0,381 \pm 0,023 \#$	$0,012 \pm 0,001$
RGPEM	$0,052 \pm 0,009 \#$	$0,055 \pm 0,009 \#$	$0,29 \pm 0,005$
Degree of erythrocyte membranes deformation	$3 \pm 0,0 \#$	$2,9 \pm 0,0 \#$	$1,1 \pm 0,1$
Erythrocytes	$4,09 \pm 0,1$	$4,26 \pm 0,1$	$4,07 \pm 0,0$
Crystal-optical characteristics of blood serum	$2 \pm 0,0 \#$	$2 \pm 0,0 \#$	$0,1 \pm 0,1$
Hb	$138,1 \pm 2,2$	$136,9 \pm 2,8$	$135,5 \pm 2,3$
SaO ₂	$91,7 \pm 0,4 \#$	$89,6 \pm 2,1 \#$	$93,5 \pm 1,0$

Note: sign # is a statistically significant difference compared to a group of healthy individuals ($p < 0.001$).

In the II group of patients there were: the relative gradient membrane potential veraciously decreased ($0,07 \pm 0,005$), the relative charge of the erythrocyte membrane increased ($0.263 \pm 0.006 \mu V$), the number of irreversibly deformed forms of erythrocytes decreased to (1.6 ± 0.1) and hypoxic anisotropy of blood serum up to 1.0 ± 0.0 as compared with the beginning of treatment ($p < 0.05$), there was no significant difference in comparison with healthy in the estimated parameters. In terms of Hb of the total number of erythrocytes there were no significant changes occurred in any of the groups at the 14th day of treatment. The index of SaO₂ veraciously improved to (97 ± 1.4) ($p < 0.05$) in the II group only, compared with the beginning of treatment.

Conclusions

As a result of this work, the changes in the relative gradient membrane potential and the relative charge of erythrocyte membranes were first studied. The degree of deformation of erythrocytes and the features of the crystal-optical characteristics of blood serum were determined, both as indicators of deformation capacity and osmotic

resistance of these cells; Quantitative and qualitative changes that occur in the above listed indicators in the course of standard treatment were estimated.

It was revealed that in patients with COPD of moderate severity in the exacerbation period the erythrocyte membrane damage occur, which results in deterioration of the deformability and osmotic resistance of erythrocytes due to the increase in the relative gradient membrane potential and the decrease in the relative charge of erythrocytes practically to zero. Despite the adequate basic therapy and the achievement of positive clinical effect, the rheological properties of the blood deteriorated with the development of the antioxidant and oxygen-binding function violation after only 2 months.

A high inverse correlation was found between the degree of erythrocyte deformation and the level of SaO₂ (Spearman's correlation coefficient is -0.71 ± 0.02), which indicates a deterioration in the oxygen-binding properties of blood due to the appearance of disturbances in the erythrocyte link, which is very sensitive to the negative effect of the active oxygen forms.

The obtained results indicate the need for the use of new, non-medicamentous treatment methods aiming further stimulation of the body's own antioxidant defense system in the complex treatment of patients with chronic obstructive pulmonary disease. This issue is very relevant in group of patients who take a large number of medications for a long time.

We proposed singlet-oxygen therapy in the complex treatment of patients with chronic obstructive pulmonary disease of moderate severity. The positive effect of SOT on the rheological parameters of blood during exacerbation and remission in this group of patients was evaluated and proved.

The use of SOT in patients with COPD causes a stabilization of all testing blood parameters, which indicates adequate stimulation of the system's own antioxidant protection, enabling the body to neutralize excess free radicals in the process of vital activity. The method is easy to use, does not require additional training of medical personnel, does not have negative side effects, is well perceived and tolerated by patients. Therefore, we can recommend the proposed scheme of SOT, as a non-medicinal antioxidant treatment in the complex therapy of exacerbations of COPD of moderate severity in a hospital.

2.6. The effectiveness of SOM applied in complex treatment of children with nonspecific respiratory diseases

To determine the effectiveness of proposed complex therapy with the use of singlet-oxygen therapy, 38 children with chronic (CB) and relapsing (RB) bronchitis aged from 6 to 12 years were treated. The children were divided into the following groups: group I were 10 children, patients with BP and HC who received basic therapy (antibiotics, mucolytics) and singlet-oxygen therapy (with distilled water), group II were 8 children with RB and HB who received basic and singlet-oxygen therapy (with drinking water «Old Mirgorod») and the group III were 20 children, patients with RB and HB who received basic therapy.

All children, who underwent a course of singlet-oxygen therapy along with traditional treatment, received inhalation once a day for 10 minutes and drank 100 ml of activated water for 10 days.

To clarify and objectify the pathological changes in the respiratory system the instrumental studies were conducted: spirometry, to detect ventilation insufficiency, its type and the presence of bronchospasm; zone lungs rheography to identify functional and persistent disorders of regional circulation in the lungs. The examination of children was carried out in dynamics (before and after treatment).

According to the data given in Table 9, it can be seen that children with CB and RB were divided by signs of ventilation deficiency before the treatment.

Table 9. Distribution of children with CB and RB by the presence of ventilation insufficiency before the treatment, %

Ventilation insufficiency degree	Distribution of children with CB and RB		
	I Group	II Group	III Group
0	30	25	25
1	30	25	45
2	20	12,5	20
3	20	37,5	10

As it can be seen from the data in Table 9, virtually in all distribution groups, the same percentage of children with an insignificant degree of ventilation insufficiency was observed (0-1

degree). Children with medium degree of ventilation insufficiency (2-3 degree) prevailed in the II group (50%) and the least of all was in group III (30%). Thus, children who received basic plus singlet-oxygen therapy, according to the degree of ventilation deficiency, were even heavier than the control group.

The indicators of ventilation insufficiency in the groups after treatment are given in Table 10.

Table 9. Distribution of children with CB and RB by the presence of ventilation insufficiency after the treatment,%

Ventilation insufficiency degree	Distribution of children with CB and RB		
	I Group	II Group	III Group
0	50	37,5	60
1	30	37,5	20
2	20	12,5	20
3	–	12,5	–

According to the Table 10 there was a decrease in the number of manifestations of grade three ventilation insufficiency in children of all groups after treatment, but in groups that additionally received singlet-oxygen therapy, the percentage of improvement almost doubled over those of the control group. If we consider the dynamics of the ventilation insufficiency degree by the distribution groups, it turns out that it hasn't changed in 30% of the group I and in 70% it has improved, in the II group the degree of ventilation insufficiency has not change in 62.5% and its improvement was noted in 37, 5%, and in the III group 40% were without dynamics and the positive dynamics - a decrease in the degree of ventilation failure was observed in 60% of children.

According to the degree of ventilation failure before and after treatment children distributed into groups by the following order (Table 11).

As can be seen from the data in Table 11, a significant improvement is observed in the first and third groups (in which the percentage of patients with normal respiratory rates is clearly increased). Virtually no dynamics showed the second group. However, it should be noted that in 50% of children (especially this refers to the obstructive type), the speed indices of the spirogram are not getting normal, but their positive dynamics is noted. This is due to the fact that

the greatest percentage of patients with 3-d degree of ventilation failure is observed in this group.

Table 11.
Distribution of children with CB and RB by the type of ventilation failure before and after treatment,%

Ventilation insufficiency degree	Distribution of children with CB and RB					
	I Group		II Group		III Group	
	before	after	before	after	before	after
No	20	50	25,5	25,5	25	55
Obstructive	50	30	62,5	62,5	60	40
Restrictive	10	20	12,5	12,5	5	5
Mixed	20	–	–	–	10	–

It is known that not only target organs are drawn into the chronic inflammatory process, but also blood vessels that these organs nourish with blood. Other external factors (for example, the force of gravity) also affect the circulation of blood, which under normal conditions is compensated by the body, and if this compensation is inadequate, it manifests by functional disorders. This allows to register early signs of pathological changes. The study of regional blood circulation in the lungs during a clinotostatic test was carried out. If the changes in blood circulation were of a permanent nature, then they were defined as organic, and if in the supine position the changes were not detected, and in the standing position they were observed, then these violations were regarded as functional.

According to the data obtained (Table 12), children with RB and CB have a violation of regional circulation.

Table 12.
Frequency of regional circulation violations in children with RB and CB, according to zonal lungs rheography,%

Form of circulatory disorders	Distribution of children with CB and RB		
	I Group	II Group	III Group
No disorder	10	12,5	10
Functional disorder	60	38,5	55
Pathological changes	30	50	35

With functional disorders, blood circulation in the affected areas was approaching to normal in the supine position, but with rising up the blood circulation curve became similar to the «pneumosclerotic» type, due to increased hydrostatic pressure in the lungs and a decrease in their elastic properties.

It is shown from the data in Table 12, the I and III groups are almost the same by the distribution, and only in the II group there is an increase in the percentage of children with persistent changes.

After the treatment the following dynamics was observed in the regional circulatory indices: in the group I, 70% of children had an improvement in regional blood circulation and 30% had no dynamics; in the group II, 62.5% of children showed improvement, while 37.5% did not; in the group III, only 35% had an improvement, without dynamics was 45%, and in 20% of children even the deterioration of regional blood circulation indicators was observed.

Thus, we observed a significant improvement in regional blood circulation when the singlet-oxygen mixtures were used in complex therapy of RB and CB, as it was proved to reduce the risk of such a formidable complication as pneumosclerosis.

It is known that immunological resistance is the most important functional indicator that characterizes the resistance of the body to various environmental influences. Therefore, it was the immune system by which the effectiveness of the singlet-oxygen mixture was next evaluated.

According to the data that characterize the state of the immune system in children (Table 13), it is evident that only in the III group there was a significant decrease in T-lymphocytes before treatment, and in the I and II groups the distribution of the initial state of cellular immunity was satisfactory. With the use of basic therapy, the state of cellular immunity practically did not change after treatment, and when using a singlet-oxygen mixture, a significant increase in T-lymphocytes in both groups was observed, normalization of T-helpers and T-suppressors ratio, and a decrease in the NCT test. Thus, we observed a sufficiently pronounced stimulating effect of the singlet-oxygen mixture on the activity of the immune system. However, for a more probable statement about the activation of the immune system, it is necessary to study the effect of the proposed therapy on children with RB and HB and with reduced immunity.

Table 13.
Comparative characteristics of cellular immunity in
children with RB and HB before and after treatment
with immunity indices of healthy children

The groups of children with diseases	cell content, %		Index, abs.		Index, rel.	
	CD3	CD19	CD4	CD8	Tx/Tc	NCT
Group I before treatment	46,45± 1,42	16,0± 0,75	54,91± 2,01	30,9± 2,25	2,16± 0,26	27,81± 1,87
Group I after treatment	50,9± 0,83	17,63± 0,75	54,27± 1,39	32,9± 1,09	1,80± 0,12	22,45± 0,94
Group II before treatment	42,5± 1,57	20,17± 0,91	45,67± 3,33	37,17± 1,95	1,33± 0,18	30,3± 2,88
Group II after treatment	50,9± 0,83	17,64± 0,75	54,27± 1,39	32,90± 1,09	1,80± 0,12	22,45± 0,94
Group III before treatment	39,57± 0,96	15,09± 0,62	53,28± 1,44	25,52± 1,38	2,43± 0,19	34,38± 1,25
Group III after treatment	40,47± 0,89	16,19± 0,57	56,14± 1,30	21,52± 0,78	2,85± 0,17	32,52± 0,65
Healthy Group	44,13± 0,53	13,76± 0,36	51,90± 1,03	28,22± 1,13	2,05± 0,11	27,6± 0,28

It is known that bronchopulmonary pathology affects the membranes and it is caused not only by hypoxia, but also by toxicosis, an elevated level of biologically active substances, by activation of the compliment system. With the exacerbation of COPD, not only the activation of free radical oxidation takes place, but the activity of the antioxidant defense system decreases, the oxidation-reduction reactions deteriorate, the hydrolysis activates.

In stationary conditions, the body forms a mobile pro-oxidant-antioxidant equilibrium between the production of active oxygen metabolites and their removal by the antioxidant defense system. Only with significant adverse effects on the duration and intensity of the AOP (antioxydant protection), the protection becomes inadequate and uncontrolled activation of the LPO (lipids peroxide oxidation) occurs.

A necessary condition for LPO is a sufficient number of oxidation substrates, the presence of molecular oxygen in the medium, the creation of ROS, the presence of metabolites and their reducing agents. Oxygen, penetrating the body cells, is distributed between the oxidase and oxygenase pathways. Oxidase pathway is associated with the oxidation of energy substrates and is regulated by cytochrome oxidase, as a result of four-electron reduction of oxygen, water is created.

Oxygenase pathway is when there is no complete four-electron reduction, but two-three-electron reduction takes place, ROS are created, which react with endogenous substrates. The creation of ROS as a result of incomplete one-electron, two-electron (H_2O_2) or three-electron (OH^-) oxygen reduction leads to the accumulation and LPO activation (Fig. 6).

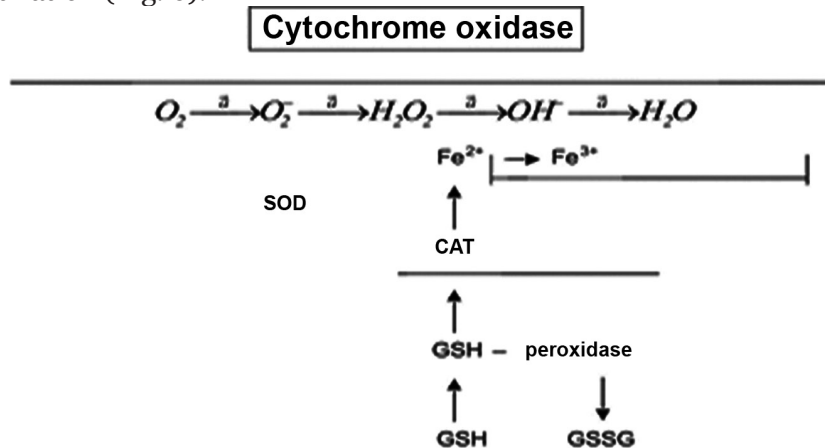
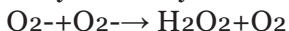


Fig. 6. Scheme of oxygen reduction in the process of biochemical reactions

Primary ROS is O_2^- - superoxide radical. Higher activity has oxygen (DO_2), which is created in the reaction of dismutation, in the absence of SOD:



As a result of the superoxide anion dismutation, H_2O_2 is produced, which has a higher cytotoxicity:



A possible source of H_2O_2 can be neutrophilic granulocytes, namely, a violation of free radical oxidation and phagocytosis.

The SOD synergist in the cells is CAT (catalase), which prevents the accumulation of the superoxide reaction products of the SOD inhibitor. CAT is the main agent that destroys H_2O_2 in tissues. Next to CAT, H_2O_2 detoxification is provided by a system of glutathione-dependent enzymes and peroxidases.

Strengthening of LPO processes destabilizes all components of cell membranes. Accumulation of primary and secondary products of LPO leads to unrestorable changes in cell membranes. MDA (malondialdehyde), as a secondary product of LPO, has the properties that result in the creation of end products of LPO- advanced lipoxidation

end-products (ALE), which are no longer subject to be metabolized. The imbalance between LPO-AOD (anti oxidant defence) is associated with the processes of intracellular oxidation reactions (IOR) in cells. The enzymatic spectrum of intracellular enzymes depends on the state of the organism. The high level of AOD system is directly dependent on the processes of intracellular respiration, the balance between aerobic and anaerobic respiration.

The main role in the oxidative phosphorylation reactions belongs to paired mitochondrial enzymes SDH (succinate dehydrogenase) and GPDH (alpha-glycerophosphate dehydrogenase). GPDH takes part in the transport of electrons from the cytoplasm to the mitochondria, promotes an increase in the biosynthesis of glycerophosphates, prevents damage to biomembranes and the disruption of their properties.

With the decrease of IOR become active the processes of anaerobic respiration - glycolysis, the activity of basic hydralases, namely acidic phosphatase and LDH (lactate dehydrogenase).

Let us consider how the intracellular metabolism and the LPO-AOD parameters change in children with RB and CB (Table 14, 16).

Table 14.
Dynamics of intracellular metabolism parameters
in children with RB and HB.

The groups of children with diseases	The parameter				
	SDH, c.u.	GPDH, c.u.	LDH, c.u.	AP of lymphocyte, c.u.	AP of neutrophils, c.u.
Group I before treatment	4,76±0,25	5,77±0,22	14,73±0,16	2,16±0,033	2,34±0,09
Group I after treatment	8,2±0,31	8,42±0,22	13,1±0,15	2,05±0,03	2,35±0,09
Group II before treatment	4,17±0,18	7,9±1,21	13,48±1,17	2,03±0,05	2,36±0,09
Group II after treatment	8,37±0,42	9,68±0,55	12,68±0,68	2,24±0,03	2,17±0,06
Group III before treatment	6,85±0,23	5,35±0,27	14,96±0,21	2,30±0,07	2,15±0,06
Group III after treatment	7,10±0,22	5,67±0,17	13,93±0,18	2,26±0,04	2,08±0,04
Healthy Group	9,44±0,24	9,05±0,12	10,4±0,03	2,0±0,02	2,03±0,02

Table 14 shows the intracellular metabolism indices, from which it can be seen that in all children with RB and CB, regardless of the distribution group, there was a significant decrease in metabolic activity in lymphocytes and neutrophils in comparison with a group of healthy children. Oppression of redox processes was reflected by a significant decrease in the activity of mitochondrial SDH and GPDH, which led to inhibition of the pentose monophosphate pathway for the utilization of carbohydrates, which in turn facilitated the activation of anaerobic processes in cells. This is indicated by an increase in LDH and AP of leukocytes and neutrophils.

An increase in the share of anaerobic processes in intracellular metabolism led to the accumulation of free radicals that activated the LPO system.

Table 15 shows the prooxidant-antioxidant system. LPO was assessed by serum level of the final product of lipid peroxidation - malonic dialdehyde.

Table 15.
The prooxidant-antioxidant system indicators.

The groups of children with diseases	Indiator		
	MDA, $\mu\text{mol/L}$	Catalase, c.u.	SOD, c.u.
Group I before treatment	2,53 \pm 0,21	49,76 \pm 2,20	2,77 \pm 0,24
Group I after treatment	1,49 \pm 0,13	134,85 \pm 5,45	3,29 \pm 0,16
Group II before treatment	2,15 \pm 0,27	54,41 \pm 11,31	2,88 \pm 0,09
Group II after treatment	5,31 \pm 0,49	106,32 \pm 11,89	3,86 \pm 0,10
Group III before treatment	2,36 \pm 0,12	63,76 \pm 3,76	1,74 \pm 0,14
Group III after treatment	2,02 \pm 0,09	70,33 \pm 5,27	2,24 \pm 0,13
Healthy Group	1,15 \pm 0,24	59,0 \pm 0,12	1,89 \pm 0,03

The enzymes that participate in oxidative phosphorylation remained virtually unchanged after treatment in children who received basic therapy, whereas in children from the groups that received singlet-oxygen therapy, there was a significant improvement in the function of these enzymes. It should be noted that with pronounced activation

of oxidative phosphorylation enzymes, there is no significant decrease in the activity of hydrolysis enzymes. This is probably due to the short treatment time and it needs further clarification.

Apparently, the level of MDA was increased in groups of patients, which confirmed the presence of destructive processes in diseases of R.Bronchitis and CB.

The antioxidant system is known to resist the excessive accumulation of free radicals. The activity of AOS-SOD key enzymes and catalase was evaluated in sick children by distribution groups. It is known that SOD neutralizes oxygen intermediates, and catalase prevents the accumulation of hydrogen peroxide, which is released during the dismutation of the superoxide anion. Thus, SOD and catalase are metabolically related.

The activity of SOD in children of the first and second groups was increased, and the catalase activity was increased in all three groups. This indicates the activation of the AOS system both at the cellular and humoral levels, which was regarded as a compensatory response to the activation of LPO.

It turned out after treatment that children from the basic therapy group had a possible decrease in MDA. However, this decrease is relatively insignificant and the activity of LPO is also observed after treatment. Quite interesting data we obtained in groups that received singlet-oxygen therapy. In the first group of children who drank activated distilled water, MDA practically returned to normal values, and in the second group, where was used activated water «Stary Mirgorod», the level of MDA in blood increased significantly. Perhaps this is due to the fact that during the singlet-oxygen mixture passing through the water «Old Mirgorod» the free-radical compounds were formed, which activated LPO.

At the same time, as can be seen from the data given in Table 15, under the action of the singlet-oxygen mixture there was a significant activation of the AOD enzymes, especially catalase, in contrast to the third group, where children received basic therapy.

Thus, the use of singlet-oxygen therapy (distilled water) affects two links of LPO-AOD, which is very important in the treatment of chronic pathology. The use of singlet-oxygen therapy (with the activation of any drinking water) needs to be carefully studied in connection with the fact that there may be undesirable and unforeseen effects.

Thus, the performed work showed that the use of singlet-oxygen mixture in the complex therapy of RB and CB during the exacerbation is pathogenetically based, and promotes more rapid improvement in the health status of patients.

Conclusions and practical recommendations

The clinical effect of singlet-oxygen therapy is based on the restoration of oxidative phosphorylation enzymes activity, of the level of hydroperoxides and antioxidant protection parameters, which was not observed after traditional treatment. When using singlet-oxygen therapy, regional blood circulation of the lungs in patients with NLD (nonspecific lung diseases) significantly improves, which helps to prevent pneumosclerotic complications.

Institutions of practical health care are offered a new method of treatment - non-invasive, easy to use, without side effects and complications, which is recommended to be used in conjunction with traditional treatment for children with RB and HB during exacerbation, regardless of disease severity.

Singlet oxygen therapy is recommended to be used during the period of remission for the prevention of exacerbation according to the scheme described in the device user manual. The interval between treatment courses is not less than two months.

2.7. Comparative analysis of singlet oxygen and oxygen cocktails used in patients with chronic obstructive bronchitis in conditions of complex sanatorium treatment on the South Coast

A singlet-oxygen cocktail is obtained by passing of singlet-oxygen mixture through a special solution like: holosas; raspberry syrup; syrup of licorice root.

Singlet (activated) oxygen is formed when a steam-water mixture passes through an ultraviolet-magnetic activator. The creation of an additional magnetic field in the ultraviolet activator promotes the activation of the formation of singlet-oxygen compounds; the energy stability and the effectiveness of therapeutic action increase.

In 2003, 123 patients with chronic obstructive bronchitis were treated at the «Eagle's Nest» sanatorium, of which 50 people received a singlet-oxygen cocktail in complex treatment (using the MIT-S apparatus/foams); 50 patients received an oxygen cocktail.

The changes in clinical symptoms in patients with chronic obstructive bronchitis in complex treatment with singlet-oxygen and oxygen cocktails are given in Table 16.

Table 16.
Changes in clinical symptoms in patients with chronic obstructive bronchitis in complex treatment with singlet oxygen and oxygen cocktails

Symptom	% of patients with a decrease in symptoms with the use of singlet oxygen cocktails	% of patients with a decrease in symptoms when applied oxygen cocktails
Cough	96	90
Sputum	98	92
Dyspnea	92	86

Based on the results of treatment of patients, namely, a reduction in cough, sputum, dyspnea, and an increase in exercise tolerance and improvement in the function of external respiration, we conclude that the use of singlet-oxygen cocktails is more effective than oxygen cocktails.

It should be taken into account that when using the machine for singlet-oxygen cocktails and foams MIT-S, there is no need for extra costs for the delivery and maintenance of oxygen bottles. These all make the machine MIT-S more attractive for use in comparison with traditional oxygen cocktails machines with oxygen bottles.

2.8. Singlet-oxygen therapy of chronic tonsillitis

Chronic tonsillitis is one of the most common diseases, especially in childhood. The course of tonsillitis is often accompanied by complications in the form of diseases of the cardiovascular system, kidneys, connective tissue, etc. It is also noted that in chronic tonsillitis the immunity is significantly reduced, and the elements of chronic fatigue are revealed in children. Naturally, the treatment of chronic tonsillitis is an important medical and social task. A large number of physiotherapeutic methods in the therapy of this disease has been proposed. In recent years, the SOT is being introduced more widely, as an absolutely safe and effective method. At the same time, it is desirable

to perform the SOT taking into account the biological processes both in tonsils in the organism in general.

A group of scientists (DI Tarasov, AB Shevrygin, NA Chesnokov) for a long time (about 10 years) had been studied the functional properties of tonsils in children in normal state and with different forms of tonsillitis from the standpoint of chronobiology. The main attention was focused on the study of such ancient physiological adaptive reactions as phagocytosis, which was studied in smear-prints taken four times throughout the day.

The obtained data showed a clearly expressed biorhythm of neutrophils phagocytic activity in tonsils in norm and pathology, with the greatest activity observed at 12 noon. Thus, the percentage of daily average phagocytic index of patients to the average daily value in healthy children was expressed in the following values: at 8:00 - plus 19%, at 12:00 - plus 55, at 16:00 - plus 5, at 20:00 - minus 40 percent. When studying the biorhythms of phagocytosis in dependence on the age of children, was revealed their two-wave character both in healthy and in children with frequent tonsillitis and chronic tonsillitis. The first rise in phagocytosis activity in tonsils is observed at the age of 3-4 years, the second - in the pubertal period.

The revealed specific biorhythm of phagocytosis in tonsils in healthy and sick children with an acrophase at 12 o'clock in the noon is certainly a nonspecific reaction. At the same time, it reflects the whole lymphoid pharyngeal ring functioning biorhythm as one of the dynamic adaptive reactions of the whole organism.

At the same time in chronic tonsillitis the biorhythm is strongly inhibited, and the degree of intensity decrease and dynamism of phagocytosis of tonsil neutrophils is directly dependent on the severity of clinical manifestations of this disease. So, if the amplitude of fluctuations of the phagocytic index in healthy children in averaged is 15.4, and with simple chronic tonsillitis – 13.0, then in chronic tonsillitis with tonsillogenic toxicity this value drops sharply to 5.0, and in chronic tonsillitis with different complications up to 2.0.

The main value of this study is that as a result of studying the physiological and pathophysiological properties of the tonsils, a biorhythm of the functional properties of the lymphoid tissue of the tonsils was revealed, which has not been taken into account before in numerous studies.

Table 17 shows the scheme of the use of singlet-oxygen mixtures for treatment the chronic tonsillitis.

Table 17.
SOT in chronic tonsillitis.

Days of treatment	The amount of SOM for gargling, ml	The amount of SOM for taking per os, ml	Time of inhalation, min	Treatment schedule
1-3	200	100	5	1. Morning (after waking up, 7: 00-8: 00): rinsing throat with SOM.
4-7	200-150	150	7	2. 11:30: gargling, inhalation of SOM, ingestion of SOM.
8-15	150	150-200	9	3. Between 17:00-19:00 - gargling, taking SOM per os.
16-21	150	200	9	4. From the 4th day - procedures every other day, rinses daily. 5. The duration of treatment is 20-21 days.

Combining SOT with other procedures:

- Low-frequency ultrasound for the projection of tonsils before the day-time of SOT procedure - up to 10 sessions;
- magneto-laser therapy in days when there are no SOT sessions (except rinse) and UST (ultrasound therapy);
- homeopathic therapy, etc.

The developed method of SOT takes into account the biorhythmological activity of phagocytes of the tonsils in chronic tonsillitis.

2.9. Inhalation singlet-oxygen phytotherapy

This method is based on the use of small amounts of essential oils solutions (EOs) (1-3 drops), which are treated with SOM, followed by inhalation. This combination (SOM+essential oils) has more purposeful therapeutic effect, which is associated with the spectrum of the biolytic activity of essential oils (G.N. Ponomarenko et al., 1998, table 18).

The following features of the essential oils antibacterial action are noted:

- their activity against antibiotic-resistant forms of microorganisms;

- Increasing the effect of antibiotics, which makes it possible to increase the effectiveness of the medicine and reduce its dose.

Table 18.
Spectrum of biological activity of the most commonly used essential oils

The effect	Mint	Lavender	Sage	Anise	Fenchel	Fir	Eucalyptus	Citral
Anti-inflammatory	+	+	+					
Antimicrobial		+			+	+	+	
Antiseptic	+	+	+		+	+	+	
Bronchospasmolytic	+			+	+			
Expectorant				+			+	
General-stimulating	+		+	+			+	+
Sedative		+	+	+				
Painkiller		+						

The effect of EO and their constituent components extends to different types of viruses. When studying the antiviral effect of mint, sage, oregano essential oils in conditions of direct contact with the influenza virus, it was proved that they have a direct virucidal effect. EO destroy the lipid layer of vibrios, leading to the elimination of covering proteins from them, thereby inactivating the virus.

In the study of the EOs effect on blood cells, it was noted that they prevent hemolysis of erythrocytes, inhibit platelet aggregation, activate phagocytosis. EOs play an important role in the metabolism, also performing the role of bioantioxidants.

How to perform the SOM inhalation procedure

1. Connect the silicone outlet tube to the output connection CHANNEL I and CHANNEL II.
2. Connect the inhalation tip to the silicone outlet tube.
3. Give the inhalation tip to the patient and instruct the patient about the method of inhalation. Optimal procedure takes 5-7 minutes.

4. To increase the effectiveness of SOM inhalation add 1-2 drops of essential oil (e.g., eucalyptus, lavender, mint, anise, etc., or essential oil composition such as «MENTOCLAR», etc.) to the distilled water of the reaction flask lower glass

Preparation of activated water

1. Connect the nebulizers from the delivery set of the device to the output end of the silicone tubes connected to the CHANNEL I and CHANNEL II fittings on the front panel of the electronic unit.
2. Place the atomizer into container with distilled water (optimal volume 150-200 ml) or an aqueous solution to be activated.
3. The preparation time of 200 ml activated water (aqueous solution) is 7-9 min (7 min for water and 9 min for water solution).
4. Instead of distilled water can be used boiled, standing water of room temperature, and non-carbonated mineral waters, phytophores and other liquids can be used as aqueous solutions.

How to prepare a singlet-oxygen cocktail or foam

1. To prepare the cocktail, also use a sprayer mounted on the end of the output silicone tube.
2. To obtain 7-8 (100 ml) portions of the cocktail, 1-liter container should be used.
3. The cocktail activation time is 7-9 minutes.
4. The cocktail is a 1:1 mixture of distilled or boiled water with phyto-tea (medicinal tinctures) containing a small amount of sugar, otherwise a singlet-oxygen foam is formed, which is obtained by using a mixture of distilled, boiled or mineral non-carbonated water with fruit juices and the use of additives for better foaming.
5. Additives can be very diverse - rose hips infusion, glucose, vitamins B and C, infusion of medicinal plants, for example, cholic or laxatives. In order to make the foam thicker, add 10 ml of licorice syrup or a kvass concentrate into 200 ml of the cocktail. Since the effect of the procedure depends on the additives, they are chosen not to taste, but to their prescription. So for the case of patients with diabetes, preference should be given to additives

that do not contain sugar, or to mix cocktail and foams with fructose.

6. Consume a cocktail or foam slowly (for taking a portion spend 1-2 minutes). Not less than 200 ml of a cocktail or equivalent amount of foam is recommended for one procedure.
7. 10-12 procedures are required for prevention, and for treatment of a disease – 18-24 procedures. It should be remembered that a cocktail or foam is not recommended for taking on an empty stomach, at least an hour after a meal.

3. DRINKING METHODS OF SINGLE-OXYGEN THERAPY

The use of SOT in the form of intake the liquids, phytotea, mineral water, etc., activated by SOM, may be either an independent option for recovery and treatment or a part of complex medical rehabilitation. Preparation of the singlet-oxygen mixture, i.e. its composition, is determined by doctor depending on a disease, stage, etc. For example, in diseases of the liver, bile duct and gall bladder, the activation of Morshin water is recommended, in hypoacid gastritis – Mirgorod, etc.

If there is no proper mineral water or if it is difficult to choose, use distilled water.

When prescribing activated SOM phytoteas, infusions, decoctions, etc., the therapeutic effect of phytopreparation (sedative, tonic, immunomodulating, etc.) is taken into account.

Note that the SOM activation of the appropriate decoction or infusion, enhances its effect with the registration of therapeutic synergism.

To obtain the maximum therapeutic effect of SCT in drinking techniques, as well as with inhalation, functional biorhythms of organs and body systems should be taken into account. Table 19 shows the intra-day biological rhythms of the main systems (meridians) of the body according to the data of Eastern medicine. Note that given biorhythms are the most stable in the body, which is confirmed by modern highly informative methods. For example, daily ph-metric of gastric juice, diurnal or more prolonged recording of blood pressure, ECG, etc.

The peculiarity of carrying out SOT taking into account biorhythmic processes is as follows. The procedure is carried out an hour or 30 minutes before the onset of a hyper- or hypo-functional state of the system. For example, with hyperacidity gastritis, the intake of a singlet-oxygen mixture prepared on the basis of hydrocarbonate sodium (alkaline) mineral water is carried out at 6 or 6:30 a.m. (maximum activity of the stomach meridian from 7 to 9 am). In the case of hypoacid gastritis, the SOT procedure is performed with the use of hydrocarbonate-chloride-sodium mineral water at 6-6:40 p.m. (hypo-functional state of the stomach meridian from 7 to 9 p.m).

In the same way, drinking SOT is performed in other diseases. For example, in cases of kidney sand, taking SOM «Naftusya» is held at 4-4:30 p.m., and with a hypotonic gallbladder - SOM on the

«Morshinska» mineral water at 10-10:30 am. Of special importance is to carry out the SOT taking into account biological rhythms in the treatment of serious diseases that are not easily treated.

Table 19.
The intra-day biological rhythms of the main systems (meridians) of the body according to Eastern Traditional Medicine.

#	Name of the meridian or system	Hours of maximum activity	Hours of minimum activity
1	Lungs - P (I)	3-5	15-17
2	Large intestine - GJ (II)	5-7	17-19
3	Stomach - E (III)	7-9	19-21
4	Spleen - pancreas - RP (IV)	9-11	21-23
5	Heart - C (V)	11-13	23-1
6	Small intestine - JG (VI)	13-15	1-3
7	Bladder - V (VII)	15-17	3-5
8	Kidneys - R (VIII)	17-19	5-7
9	Cardiovascular and sexual sphere (pericardium or brain) - MC (IX)	19-21	7-9
10	Three parts of the trunk (spinal cord) -TR (X)	21-23	9-11
11	Gallbladder-VB (XI)	23-1	11-13
12	Liver - F (XII)	1-3	13-15

We also recommend to perform preventive (supportive) courses of SOT taking into account seasonal biological rhythms (Table 19). The table provides data (timing), when the functional systems work most severely with possible decompensation of the process in chronic pathology. SOT sessions, possibly in combination with other methods of physiotherapy, are carried out 10-15 days before the expected exacerbation or decompensation.

For example, in chronic kidney diseases (pyelonephritis, etc.), the course of SOT begins at the beginning of November, and in chronic liver pathology in the beginning of February.

Particularly highlighted in the seasonal biorhythms is «INTERSEASON», when pancreas and stomach diseases, as well as systemic connective tissue diseases exacerbation are possible. In such cases, supportive (preventive) courses of SOT should be conducted four times a year (from 5 to 15 sessions).

3.1. Singlet-oxygen therapy in gastro-and nephropathies associated with the use of non-steroidal anti-inflammatory drugs (NSAIDs)

According to WHO, about 20% of the population regularly take NSAIDs. The main indications for their appointment are inflammatory processes of various nature and localization, pain syndrome and fever of different etiology, they are also used for the prevention of arterial thrombosis (aspirin).

The mechanism of NSAIDs action is inhibition of cyclooxygenase (COX-1 and 2). At the same time, the violation of the gastrointestinal tract (GIT) mucosa protective mechanisms and the processes of platelet aggregation are the result of COX-1 oppression, which leads to the prostaglandins synthesis suppression and the development of a number of side effects.

Depending on the selectivity of the effect on COX-1, all NSAIDs are divided into three groups:

- non-selective (diclofenac, ibuprofen, indomethacin, piroxicam);
- relatively selective (meloxicam, nimesulide);
- highly selective (celecoxib, voldecocib).

NSAIDs cause a number of side effects from the gastrointestinal tract: dyspepsia (in 20-40% of cases), erosive-ulcerative lesions (10-20%), gastrointestinal bleeding (up to 5%), enteropathy, and also have a hepatotoxic effect.

The mucous membrane of the stomach is normally protected from aggressive agents (hydrochloric acid, pepsin, H. pylori) by a number of protective factors (mucous layer, bicarbonates, etc.). NSAIDs inhibit the synthesis of prostaglandins, as a result of which the production of mucus and bicarbonates decreases, the regeneration of the mucous membrane deteriorates, and is damaged under the influence of aggressive factors.

The first step in the treatment of NSAID-dependent gastropathy is the identification of risk factors. The main risk factors for the development of NSAID-gastropathy include age over 65 years, the presence of gastrointestinal disease in anamnesis, infection with H. pylori, concomitant diseases, simultaneous intake of several NSAIDs, glucocorticoids, anticoagulants. If there are two or more risk factors, selective NSAIDs should be used, and antacids or, if necessary, proton pump inhibitors to prevent mucosal damage.

The Maastricht Consensus III (2005) states that the risk of erosion and gastroduodenal ulcer disease when taking NSAIDs is significantly higher if *H. pylori* is present.

With the most common manifestation of NSAID-dependent gastropathy - dyspepsia - the drugs of choice are nonabsorbable aluminum-magnesium antacids.

One of the most commonly prescribed antacids is Maalox. It contains a balanced combination of aluminum and magnesium hydroxides.

Serious complications are also registered by other organs and systems, especially the kidneys.

On November 1, 2006, the «American Journal of Epidemiology» magazine published the results of a case-control cohort study to determine the relationship between NSAID intake and hospitalization due to acute renal failure (ARF).

Data were collected on 88,768 Canadian patients over the age of 65 taking NSAIDs. It was revealed that within 30 days after initiation of therapy with any of the NSAIDs, the risk of acute renal failure developing increases by 2.05 times, after which it gradually decreases. When taking celecoxib, the risk increased by 1.54 times, rofecoxib - 2.31 times, naproxen - 2.42 times, other selective NSAIDs - 2.3 times. The authors recommend physicians to prescribe nonselective NSAIDs at the lowest dosage for use in a limited period and monitor kidney function for 2 weeks after initiation of therapy.

These or other complications when taking NSAIDs again emphasize that there are no harmless and safe chemotherapeutic drugs and their reception should be as limited as possible.

Regarding the use of SOT for the NSAIDs complications prevention.

Option 1. The SOT is performed in parallel with the intake of NSAIDs, without waiting for any complications, to prevent.

Table 20.
SOT for the prevention of gastropathies with
the administration of NSAIDs

Treatment regimen	Amount of SOM for taking per os, ml	Time of procedure
Each other day		Morning hours (20 minutes before breakfast)
First administration	100	
Second administration	150	
Third and following	200	

Usually 5-7 procedures are sufficient for preventive purposes, since it is not necessary to prescribe NSAIDs for more than two weeks. The SOT regimen for the prevention of nephropathy is about the same, but the procedure for taking SOM should be performed in the afternoon, optimally at 16 hours. In patients with a burdened «nephrologic» or «gastrological» anamnesis, SOT is performed an hour to 1.5 hours before NSAID administration. SOT is also performed on a daily basis in combination with multivitamins (antioxidants). In cases of developed gastropathy, SOT is carried out as follows (Table 21, see page 54).

It is preferable to use hydrocarbonate-sulfate waters of the Polyana Kvasova type for carrying out SOT and preparing SOM. In approximately the same way, SOT is performed in nephropathies associated with the treatment by NSAIDs. The difference lies in the fact that morning and evening procedures are performed without inhaled SOM, and daytime (preferably 16:00-16:30), inhalation and taking SOM per os.

Possible combinations of SOT with other physiotherapeutic procedures:

- supervascular blood irradiation;
- magnetolaser therapy;
- UST for segmental areas.

Table 21.
SOT regimen for gastropathies after treatment with NSAIDs

Days of treatment	Amount of SOM for taking per os, ml	Time of inhalation	The daytime for performing the procedure
1 – 2	100	4	Morning procedure from 7:00 to 9:00 for 30 - 40 minutes. before meals
3 – 5	150	5	Day treatment (without inhalation)
6 – 10	200	7	Evening procedure in the time interval of 19 - 21 hours (for 30-40 minutes before dinner)
11 – 15	200	9	
16 – 19	200	9	

4. SINGLE-OXYGEN THERAPY IN COMPLEX TREATMENT OF CARDIOVASCULAR DISEASES

Firstly, we should note that synglet-oxygen therapy is used for diseases of the cardiovascular system (CVS) in conjunction with the necessary medication and other options methods of physiotherapy.

Diseases of the cardiovascular system or cardiovascular diseases (CVDs) belong to the «civilizational» diseases of our time and are leading among the causes of death and disability in persons of working age. In this case, the leading place is occupied by ischemic heart disease (IHD) and stroke, being the cause of every third death in the world. Annually 7.2 millions of people die from myocardial infarction and 5.5 millions from a stroke. In Ukraine, the number of strokes is almost 3 times higher than the number of myocardial infarctions.

CVDs risk factors

There are a number of determined risk factors that can be divided into two groups: modifiable (they can be influenced) and not modifiable (they can not be influenced).

Modifiable risk factors:

- Hypertension;
- Dyslipidemia;
- Diabetes / impaired glucose tolerance;
- Tobacco smoking;
- Obesity (BMI=30);
- Low physical activity.

Unmodifiable risk factors:

- Age (>55 years for men, >65 years for women);
- Male;
- Family history of early CVDs;
- Microalbuminuria or GFR <60 mL/min.

Modern approaches to treatment

It is proved that the modification of risk factors reduces morbidity and mortality associated with CVDs.

The change of lifestyle including weight loss, cessation of smoking, regular exercise, moderate alcohol consumption and dietary restriction of salt and fats. The main risk factors that require pharmacological intervention are hypertension, dyslipidemia and diabetes mellitus / impaired glucose tolerance. These factors can be modified with the

help of various classes medications: antihypertensive, antiplatelet, oral anticoagulants, statins, oral hypoglycemic drugs and insulin.

Of particular importance in recent years is the research of arterial hypertension and atherosclerosis great role in the emergence of CVDs. Atherosclerosis (atherosclerosis, from Greek 'athere' - porridge, 'sklerosis' - compaction, hardening) is a common chronic disease characterized by systemic elastic lesions of the arteries. There are foci of lipid infiltration in the walls of the arteries and proliferation of connective tissue with the formation of fibrous plaques, which narrow the lumen and disrupt the physiological functions of the affected arteries. This leads to organ and / or general circulatory disorders. The main cause of atherosclerosis is hypercholesterolemia, or more precisely, specific changes in the lipid spectrum of the blood, characterized by a high level of pro-atherogenic lipids: low-density lipoprotein cholesterol (LDL) and very low density (VLDL), triglycerides (TG), chylomicrons and their transport proteins, apolipoprotein B , lipoprotein (a). Today, atherogenic particles are considered to be less than 70 nm in diameter, since they, by penetrating the endothelium, are capable of excess deposition in the wall of the vessel. Also important is the low level of anti-atherogenic high-density lipoprotein (HDL) cholesterol and its transport protein apo-AI.

Among the methods of differentiated correction of lipid spectrum disorders, the following are distinguished:

- Non-drug (anti-atherosclerotic diet, exercise, elimination of risk factors).
- Medicamentous (pharmacotherapy with statins, fibrates, drugs of nicotinic acid, sequestrants of bile acids).
- Surgical (bypass surgery of a part of the small intestine, plasmapheresis of LDL).

The ability of these methods to inhibit the progression of atherosclerosis and even cause its partial regression is established. The most effective among methods and means were HMG-CoA-reductase inhibitors, i.e. statins, that inhibit the synthesis of cholesterol at the level of mevalonic acid formation, the precursor of cholesterol. In 1980, a powerful inhibitor of HMG-CoA-reductase, lovastatin, was isolated in the soil of the fungal microorganism *Aspergillus terreus*. In clinical practice, it was introduced in 1987.

The comprehensive evaluation of lovastatin in numerous scientific studies and the rich experience of clinical application allow us to consider it as a reference preparation of the statin group.

Lipophilic properties of lovastatin provide a selective effect on the synthesis of cholesterol in the liver. It inhibits the synthesis of endogenous cholesterol in the initial stage, due to which there is a significant decrease in the blood plasma of total cholesterol, LDL and VLDL, apolipoprotein B and an increase in the content of HDL, which have an anti-atherogenic effect. To a lesser extent, the drug reduces the level of triglycerides.

The so-called non-lipid or pleiotropic therapeutic effects are also important, which do not depend on the main mechanism of action of Liprox (one of the brand names of the drug from the group of statins). The main pleiotropic effects of Liprox:

- Improves endothelial function, which subsequently leads to the elimination of myocardial ischemia symptoms;
- Thrombus formation inhibition;
- Anti-inflammatory effect;
- Stabilization of atherosclerotic plaque;
- Prevention of progressive thickening of the walls of blood vessels;
- Liprox improves endothelial function, thereby contributing to the expansion of coronary arteries in atherosclerosis.

Violation of endothelial function is characterized by an imbalance between vasodilating and vasoconstrictor mediators acting on the vascular wall. In this case, as a rule, the number of vasodilators decreases, including nitric oxide (NO) and prostacyclin, and the number of vasoconstrictors - endothelin-I and angiotensin II - increases.

The improvement of endothelial function against statins is realized in two ways: indirectly through the normalization of the lipid spectrum of the blood and by direct action on the endothelium due to vasodilator enhancement (increased NO synthesis by the endothelium under the influence of lovastatin) and decreased vasoconstrictor activity (lovastatin indirectly reduces the synthesis of endothelin-I) in the vascular wall, regardless of the effect on the lipid spectrum of the blood.

Studies have shown that there is a direct correlation between the degree of decrease in LDL cholesterol under the influence of statin therapy and the frequency of clinical events. One of the last meta-analyses (12 studies, 90,000 patients) showed that with a decrease in LDL cholesterol for every mmol / L, the risk of death from ischemic heart disease decreases by 19%, and not by fatal MI by 26% (Cholesterol Treatment Trialists (CTT) Collaborators, Lancet 2005, 366: 1267-78).

The American recommendations of the ANA/ACC (2006) indicate that the target level of LDL-C should be <100 mg/dL (about 2.6 mmol/L) (class 1, level of evidence A).

However, in some studies, the clinical effect was not proportional to the degree of decrease in the level of atherogenic cholesterol. It seems that 70 mg/dl is no longer physiologically feasible to overcome the barrier.

In addition, statins have an anti-inflammatory effect in the vessels, the indicator of which can be the content of C-reactive protein.

It was also established that the higher is the C-reactive protein level (hsCRP - «high sensitive CRP», the independent precursor of future cardiovascular incidents) in the patient's blood, the higher is the mortality from them. Lovastatin reduces the concentration of C-reactive protein by 14.8% ($p < 0.001$), and this effect does not depend on the effect on inhibition of cholesterol synthesis.

Statins also contribute to the stabilization of atherosclerotic plaque, inhibit thrombus formation, prevent the progression of thickening of the vessel walls. Important studies have been conducted to study the efficacy of atorvastatin (Liprimar, Pfizer Inc.) in patients who underwent traumatic spinal cord injury (I. Sing, 2007). For the first time, it has been shown that the use of atorvastatin significantly speeds up recovery and reduces secondary tissue damage. It is also important that scientists have discovered the ability of atorvastatin to protect cells responsible for the synthesis of myelin in the spinal cord. Damage to the spinal cord is one of the leading causes of disability. The current therapy with high doses of corticosteroids is ineffective. Statins, including atorvastatin, are classed as drugs that affect multiple cellular processes in the body. In the experimental studies, the neuroprotective efficacy of statins is susceptible.

Today, it is generally accepted that the place, nature and duration of the secondary inflammation that develops immediately after spinal cord injury determine the volume of functional loss or paralysis, and the early therapeutic effect on these factors can reduce the function decrease and accelerate rehabilitation. As a result, anti-inflammatory and neuroprotective drugs, including statins, are used as the first line of defense in spinal traumas.

According to the director of the Institute of Pediatrics, Derby, Pennsylvania, USA, Professor Mary Bernard, this study suggests that atorvastatin protects neurons and cells producing myelin during the inflammatory «storm» that develops after trauma. Thus, most studies

assess statins as an effective means to reduce LDL cholesterol levels and thereby reduce the risk of cardiovascular events.

At the same time, a significant proportion (up to 70%) of patients who underwent large coronary events in 4S, LIPID, HPS, CARE, WOS, AFCAPS and TexCAPS studies indicates that when prescribing statins even in high doses, we prevent cardiovascular diseases, vascular accidents only in a third of patients. There is no evidence of a significant reduction in mortality due to stroke on the background of statin therapy, although with a decrease in LDL cholesterol level by 1 mmol / l, the probability of any stroke is reduced by 17%, and ischemic stroke by 19%. Apparently, the decrease in the level of LDL cholesterol as a way to affect atherosclerosis and its complications has already exhausted itself, because lowering the cholesterol below 2.0 mmol / l is not physiological. Reducing LDL cholesterol by 1% reduces cardiovascular risk by 1%, and a 1% increase in HDL cholesterol reduces this risk by 3%. Thus, the increase in HDL cholesterol is a new prospect for reducing cardiovascular risk, although the level of HDL cholesterol is amenable to correction much worse than atherogenic cholesterol (M.I. Lutai, 2007)¹.

There are other counterarguments that support the limitation of statin use, especially in patients with heart failure (HF). First, the level of cholesterol is correlated with the severity of the patient's condition. Hypocholesterolemia is noted with cachexia in the terminal stage of chronic heart failure (CHF). It is proved that the low level of cholesterol in patients with CHF is an independent predictor of death. Secondly, statins inhibit the synthesis of ubiquinone, a component of the mitochondrial respiratory chain. Thirdly, lipoproteins are necessary for neutralization of bacterial polysaccharides - inducers of the formation of pro-inflammatory cytokines (L.G. Voronkov, 2007).

In addition, it is known that in 3-5% of cases, statins can increase serum transaminase levels, so their use in patients with severe CHF and sometimes concomitant with hepatic dysfunction may be problematic.

There is also evidence that long-term use of statins has an additional risk of cancer on at least 19%. «Sensitivity» of patients

¹ Lutay M.I., Voronkov L.G., B.N. Mankovsky. Statins in the prevention of MI complications in patients with IHD, patients with diabetes mellitus and heart failure // Health of Ukraine, 2007. - №3 (160) - p.32-34.

taking statins against viral diseases, intercurrent infections increases. Remaining beyond the attention of followers about the decline in sexual functions, especially in men.

Therefore, statins should not be considered an ideal drug for reducing LDL cholesterol, and the search for a «magic bullet» continues. Perhaps researchers should pay attention to physical factors, which in many cases are more effective than pharmaceuticals.

For example, our studies using magnetolaser-ultrasound-therapy (MLUST) on the projection of the liver showed that this method in course treatment not only reduced the level of LDL cholesterol, but also raised the level of HDL cholesterol. At the same time, such changes were registered during the monthly course of MLUST, whereas treatment with statins should last for years!

The main mechanism of the MLUST effect on lipid metabolism is associated with the stimulation of cytochrome P-450, that has been proven experimentally by T.A. Zolotareva (2000). This unique enzyme (cytochrome P-450) «deals» not only with detoxification (utilization of various xenobiotics), but also «translates» low-density lipoproteins into bile acids and bile. The action of statins, on the contrary, is associated with the suppression of cholesterol synthesis in the liver.

It is necessary not only to search for effective pharmaceuticals that can regulate lipid metabolism without side effects, but also to introduce physical methods of therapy. Three to four MLUST courses of 15-20 sessions per year are able to maintain the level of blood cholesterol in the normal parameters. It is clear that the MLUST should be combined with physical activity, diet, control of blood pressure and sugar in the blood. In the last 3 years we use singlet-oxygen therapy for CVDs according to the following procedure (Table 22) in addition to the conventional methods of physiotherapy including MLUST.

Table 22.

The regime of singlet-oxygen therapy in cardiovascular diseases.

Day of treatment	The amount of SOM for taking per os, ml	The inhalation duration, min	Note
1	100	3	SOT is conducted in cycles of 5 sessions, 1 procedure per day followed by a 2-day break. During the SOT, antioxidant intake is recommended. The optimal time for the procedure is after supper, during the period of cardiovascular meridian activity - MS (IX), 19 - 21 hours.
2	100	5	
3	150	5	
4	150	7	
5	150	7	
6	150	7	
7	150	9	
8	150	9	
9	200	9	
10	200	9	
2 days break			

Further treatment: inhalation for 9 minutes, ingestion 200 ml of SOM. Up to 25-30 complex procedures for the course of treatment in total. Possible mistakes in Doctor's assignment: unreasonably reduces or increases the duration of the SOT procedure; does not prescribe antioxidants; does not prescribe other methods of physiotherapy, exercise therapy. Possible mistakes of the nurse: does not observe the time SOT procedure; prepares the SOM before the start of procedure; does not explain to the patient the peculiarities of his behavior immediately after the procedure.

The SOT procedures can be combined with:

- Necessary medication;
- Magnetolaser ultrasound therapy;
- Advanced (over-arterial) laser radiation of blood;
- Exercise therapy, massage;
- Electrophoresis of medicinal substances;
- Balneotherapy;
- Regulatory puncture physiotherapy.

4.1. Arterial hypertension: tactics of complex therapy and peculiarities of SCT

At the very beginning let's designate that SOT is an additional method of arterial hypertension (AHT) treatment, like other

methods of physiotherapy. The main ones in the control of blood pressure are medications. Modern tactics of managing patients with uncomplicated hypertension is as follows. Recommendations are available on the website https://www.guideline.gov/summaries/summary/48192/2014-evidencebased-guideline-for-the-management-of-high-blood-pressure-in-adults-report-from-the-panel-members-appointed-to-the-eighth-joint-national-committee-jnc-8?_q_=Hypertension+guidelines.

Definition of arterial hypertensionThe CMI recommendation team uses the definition of hypertension (AHT) as an achievement or elevation in arterial pressure (AP) levels of 140/90 mm Hg. The recommendations concern uncomplicated hypertension, which is defined as hypertension in adult men and women (non-pregnant) without diabetes, heart failure, renal failure, or diagnosed coronary heart disease according to the table below. The 7th report of the Joint National Committee for the Prevention, Detection, Control and Treatment of High Blood Pressure (JNC7) defines the ranges of AHT shown in the table 23.

Table 23

Arterial hypertension definition in range.

Arterial pressure range	Arterial pressure, mm Hg	
	Systolic (SBP)	Diastolic (DBP)
Normal	<120	<80
Prehypertension	120 – 139	80 – 89
Hypertension I degree	140 – 159	90 – 99
Hypertension II degree	≥160	≥100

Treatment of arterial hypertension

When to start pharmacologic treatment? When the individual SBP is in the range of 140 - 159 mm Hg. (grade 1) and when there is no damage to the target organs or diabetes mellitus. Pharmacologic treatment begins when the increase in blood pressure in the marked range is registered one or more months ago in relation to this registration.

If this is the first recording of high blood pressure, you need to wait about two months and start pharmacologic treatment only when the increase in blood pressure is registered again after this period.

When the individual SBP is in the range 160-179 mm Hg or DBP – 100-109 mm Hg (grade 2) and when there is no damage to target organs or diabetes, then: pharmacologic treatment begins when the increase in blood pressure in the marked range is registered one or more months ago in relation to this registration. If this is the first recording of high blood pressure, you need to wait about one month and start the pharmacotherapy only when the high blood pressure is registered again after this time.

With individual SBP equal to or greater than 180 mm Hg, or DBP - 110 mm Hg, therapy begins with the moment of its registration.

Certain target levels of office BP for hypertension

When treating a patient with hypertension, the target level of office blood pressure is 139/89 mm Hg.

Home measurement of blood pressure in diagnosis and treatment

Diagnosis of AHT is made in the doctor's office. Home measurement of AD patients is recommended for:

- Identification of low-risk individuals from the group of «white lab coat hypertension» without diseases of target organs or diabetes, which drug therapy may not be needed. These individuals have a home BP <130/80 mm Hg, but their office level is 140/90 mm Hg.
- Achievement of control in patients with uncontrolled AHT (>135/85 mm Hg at home blood pressure measurement) according to the drug treatment algorithm with confirmation of blood pressure data using phone/email/fax or other electronic communication with the patient or by a standard visit to the clinic.
- Control of hypertension by specialist for a long period of time.

First line of treatment

Thiazide diuretics are recommended as agents of the first line in the initial therapy of persons with AHT.

Initial combination therapy

Combination therapy of thiazide diuretics with angiotensin-converting enzyme (ACE inhibitors) or preparations of other groups with insensitivity to ACE inhibitors are considered as initial therapy for AHT of degree 1 and 2.

Stepwise therapy

Since most people with hypertension require more than one drug to control blood pressure, then for two drugs:

if BP is not controlled by thiazide-like diuretics, ACE inhibitors are recommended to add;

for three drugs:

if BP is not controlled by a combination of thiazide-like diuretics and an ACEI, beta-blockers are recommended to add;

for four drugs:

if BP is not controlled by a combination of thiazide-like diuretics, ACE inhibitors and beta-blockers, calcium channel blockers are recommended to add.

Concomitant therapy

Acetylsalicylic acid (ASA)

For people aged 50 to 80 years with controlled AHT by antihypertensive agents, AAS is recommended in small doses (81 mg) to reduce the possible risks of cardiovascular events (excluding death) if there is no risk of side effects (eg, gastrointestinal bleeding).

Statins

There is no evidence to recommend the use of statins in patients with AHT and the absence of other significant risk factors. In patients with AHT, the treatment of hyperlipidemia is performed taking into account its significance for general cardiovascular risk.

However, it should be noted that not everything is so simple when taking anti-hypertensive medications and statins, as noted in the brochures of pharmacological firms. The following facts are given in the article by E.A. Yarynkina (2007):

- reception of rauwolfia drugs in women caused breast cancer by 25-28% more often than among women who did not take reserpine;
- an additional risk of developing kidney carcinoma when treated with diuretics is higher by 54%, compared with patients who did not receive diuretics;
- the use of inhibitors of the antinotensin-converting enzyme increases the additional risk of oncological diseases by 59%;
- beta-blockers - the data are contradictory;
- calcium antagonists - are the safest in influencing the risk of oncological diseases. E.A. Yarynkina emphasizes that data on the risk of complications not related to the cardiovascular system in the treatment by antihypertensive drugs are few and not

systematized. Therefore, a further, more detailed study of the risk of malignancy with long-term use of antihypertensive drugs of different groups is needed.

Thus, the task of each doctor in the treatment of hypertension, in addition to achieving the necessary blood pressure indicators, is to strive to obtain this result with the use of a minimal amount of drugs and their dosages. In the initial stages of hypertension the therapy should begin without the use of drugs, which provides:

- change of the lifestyle (moderate but regular exercise, quit smoking cessation and alcohol abuse);
- diet therapy and weight loss to the required parameters (BMI <30);
- autogenic training and the ability to «overcome stressful situations»;
- psychotherapy;
- application of various options for physiotherapy, including hydro- and balneotherapy;
- application of acupuncture and regulating puncture physiotherapy;
- homeopathic and physiotherapeutic treatment;
- hirudotherapy;
- sanatorium treatment and health improvement.

Complexity in the implementation of non-drug therapies of AHT has several components:

- the belief of the patient (and the doctor!) in the potent power of the pill (the Doctor Ehrlich's magic bullet lives);
- ease of taking tablets (at home, on the robot, on the road);
- the effectiveness and harmlessness of antihypertensive drugs (and not only antihypertensive drugs) advertised by pharmaceutical companies;
- it is difficult for patient to change his or her way of life psychologically, sometimes physically;
- in order to receive necessary procedures, patient needs to visit medical institutions (loss of time, queue);
- ignorance of patients and doctors about the possibilities of «home physiotherapy»;
- the normalization of the blood pressure indices without pharmacological methods is gradual, sometimes only after 2-3 months or even 6 months.

Of course, with II - III degree of hypertension, the use of antihypertensive drugs is a necessary condition for controlling blood pressure to the required parameters. The use of SOT and other methods of physiotherapy is pathogenetically substantiated and can be used both independently and with medicinal treatment. To effectively use them, it is important to perform blood pressure Holter monitoring for 1-2 days. Determination of the BP peaks elevation is the starting point for setting the time for performing physiotherapy procedures.

In uncomplicated hypertension, the peaks of BP elevation are most often recorded in the morning and evening hours with a drop (possibly to normal numbers) at night. In the II and III stages of hypertension, a significant desynchronosis is registered in the elevation of blood pressure. In this regard, it is important for each individual patient to determine the rhythms of BP elevation and the therapeutic complex of both drug and non-drug therapy to be built taking into account such rises. The SOT should be performed in combination with other physical therapy methods (they are listed below) 1 to 1.5 hours before the expected rise in blood pressure. The recommended mode of SOT for AHT is given in Table 24.

*Table 24.
The regimen of SOT in hypertension*

The procedure number	The SOM for taking per os, ml	Inhalation duration, min	Note
1	100	3	The procedures should be performed each other day.
2	100	5	
3	150	5	
4	150	7	
5	150	7	
6	200	9	
7 and subsequent in the same dose as 6. Total course of treatment is consisted of 10 - 15 procedures.	200	9	

SOT is carried out 2 times a day for 1 - 1.5 hours before the expected rise in blood pressure. When combined with other physiotherapy procedures, SOT is performed 30-40 minutes after them. It is possible to alternate procedures: one day the SOT, another - physical therapy. Antioxidants are taken the entire course of SOT.

Possible mistakes in medical appointment: doctor does not take into account the daily fluctuations in blood pressure and the time of the procedure; does not prescribe antioxidants; does not combine with other methods of physiotherapy; does not take into account the state of the PNS, the dynamics of blood pressure and heart rate.

Mistakes in the actions of the nurse: does not observe the time of the SOT procedure release; prepares SOM for oral administration before the procedure; does not explain to the patient the specifics of his behavior immediately after the procedure.

Possible combinations of SOT:

- with multilevel system magnet-laser therapy;
- regulatory puncturing physiotherapy;
- magnet and laser therapy;
- hydro - and balneotherapy;
- exercise therapy and massage;
- medical treatment;
- homeopathic and phytotherapy.

5. THE USE OF SINGLE-OXYGEN THERAPY IN THE COMPLEX TREATMENT OF DIABETES MELLITUS

Diabetes mellitus (DM) is called the epidemic of the twenty-first century. The number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014. In 2014, 8.5% of adults aged 18 years and older had diabetes. In 2015, diabetes was the direct cause of 1.6 million deaths and in 2012 high blood glucose was the cause of another 2.2 million deaths.

The prevalence of this disease in the developed countries of the world reaches 8-10% of the population. In Ukraine, there are 1 million patients with diabetes.

Taking into account the etiological factors from 1999, according to the recommendations of the American Diabetic Association approved by the WHO, the name of the disease is used as «diabetes type 1 and type 2».

Type 1 diabetes (formerly juvenile diabetes) is 15-20% of all diabetics, accompanied by progressive or absolute insufficiency of insulin, a tendency to ketoacidosis.

Type 2 diabetes mellitus is the most common form of the disease, is observed predominantly in persons of the elderly, is characterized by relative insufficiency of insulin, is often combined with obesity and is considered as an independent risk factor for the development of cardiovascular complications (arterial hypertension, CHD, cardiovascular insufficiency, etc.).

DM is a clinically heterogeneous and etiologically multifactorial pathology. In the last decade, significant progress has been made in disclosing its pathogenesis, diagnosis and treatment. However, despite the above, there is an increase in the disease, high mortality and the frequency of complications. Regardless of the diabetes type in patients at different times from the onset of the disease, identical tissue, organ and vascular disorders are formed, which are the main cause of death of patients with diabetes.

Hyperglycemia, insulin resistance, elevated levels of free fatty acids present in diabetes, contribute to endothelial function and smooth vascular cells disorders, increase the risk of intravascular thromboembolism, which determine the deterioration of the cardiovascular outlook.

Meanwhile, the modern tactics of treatment the diabetes, in

the absence and in the presence of cardiovascular complications can provide a reduction in the degree of cardiovascular risk. It includes the use of primary and secondary prevention, which involves changes in lifestyle, the use of non-pharmacological (balanced diet regimen, physical activity, self-control, psychological help) medical therapy (hypoglycemic, hypotensive, hypolipidemic and antithrombotic) and physiotherapeutic treatments (PT) and sanatorium and resort rehabilitation. An important role in the appointment of PT is the correct and adequate choice of physiotherapeutic factor, taking into account the pathogenesis of cardiovascular complications, the state of metabolic parameters and target organs.

Methodical recommendations on the use of singlet-oxygen therapy in the complex treatment of diabetes are first issued in Ukraine and appointed to doctors endocrinologists, physiotherapists, general practitioners and sanatorium and spa facilities.

Features of metabolic disorders in diabetes mellitus

Metabolic disorders in diabetes include many factors, among which the long-term chronic insufficiency of insulin and hyperglycemia are most important.

It has been established that in the pathogenesis of the cardiovascular complications development an important role is played by separate episodes of hyperglycemia, and constantly elevated levels of blood plasma glucose, as well as its increase after eating. Hyperglycemic peaks occurring after eating cause acute toxic effects of glucose, persistent increase in glucose levels - chronic toxic effects on the organ's cell. Toxic effects of high concentrations of glucose on the vascular wall, metabolism of lipoproteins, proteins, nervous structures lead to the development of diabetic vascular complications (macro- and microangiopathy). The risk of damage to the macrovessels increases at a level of glycemia greater than 5.5 mmol/l and 7.8 mmol/l after eating, microvessels - with glycemic index >6 mmol/l, and postprandial >9 mmol/l.

Increased blood glucose levels trigger a series of biochemical changes that are the leading factors in the development of pathological lesions in the body of a patient with diabetes.

In the pathogenesis of diabetic complications one of the leading places is given to oxidative stress. It has been established

that hyperglycemia, as a result of the activation of some biochemical processes (glucose autooxidation, polyol increase, enhanced synthesis of prostanoids, glycolysis of proteins) leads to the accumulation of free radicals. As you know, a free radical is a molecule or part of it that has an unpaired electron in a molecular or external atomic orbit. The presence of such an electron gives the radical a very high oxidative ability. Increased formation of free radicals is realized both during the oxidation of carbohydrates themselves, and carbohydrates in a complex with proteins, with the autooxidation of fatty acids in triglycerides, phospholipids and esters of cholesterol. The latter damage the membrane intracellular proteins and nucleic acids, lipids, cause degradation and cell aging. Accumulation of free radical oxidation products contributes to the development of pathological processes: impairment of mitochondrial functions and changes in the synthesis of unsaturated fatty acids and prostaglandins, damage to membranes and endothelial dysfunction, hypercoagulation. Endothelial dysfunction plays an important role in the development of coronary heart disease, hypertension, atherosclerosis, cerebral circulation disorders in patients with diabetes mellitus.

Hyperglycemia promotes enhanced intracellular polyol glucose exchange and accumulation of sorbitol. Oxidation of glucose by polyol disturbs the metabolism of nitric oxide (NO) - a short-lived radical with a wide range of metabolic functions, the main endothelial dependent vasodilatation factor, messenger in the central nervous system, modulator of the neuroendocrine system. In DM, its biosynthesis in vascular endothelium and sympathetic ganglia is delayed, which manifests itself by endothelial dysfunction and the development of neuropathy. In endothelial cells and the central nervous system, nitric oxide is formed in the reactions of conversion - L arginine to citrulin, with the enzyme NO-synthetase involved. A characteristic feature of NO is its ability to quickly diffuse through the cell membrane that it synthesized into the intercellular space and just as easily penetrate into the target cells. One of the important targets is intracellular dissolved guanylate cyclase, the activation of which is accompanied by the formation of cGMP. Under the influence of the latter there is a relaxation of smooth fibers of the vessel walls. This is facilitated by direct activation of potassium channels.

In addition to the regulation of vascular tone, NO has a pronounced anti-proliferative effect, it is an endogenous neurotransmitter that inhibits leukocyte adhesion and aggregation

of platelets, implements β -adrenergic inotropic and chronotropic response in cardiomyocytes, is involved in synaptic transmission of nerve impulses in the regulation of lung function, gastrointestinal intestinal tract, etc.

Endothelial damage in the course of atherogenesis may worsen the NO-pathway of metabolism. Reduction of the NO bioavailability is characterized by increased intracellular oxidative stress and activation of genes that are sensitive to oxidation products, leading to the adhesive molecules and chemotaxis formation.

Along with changes in the carbohydrate metabolism, the leading place in the DM is the lipids metabolism violation. The damage to the protein and lipid components of cells contributes to highly toxic lipoperoxidic compounds formation and accumulation (superoxide anion – $R-O_2$, hydrogen peroxide – H_2O_2 , organic peroxides – $R-HO_2$, organic radical – $R-OH$), which enhance the processes of destabilization of cell membranes, reduce antioxidant protection (AOP), which provides a constant level of anti-oxidative potentials, neutralizing free radicals.

Free radicals are divided into 3 large groups: reactive oxygen radicals (superoxide, hydroxyl, peroxide, alkoxyl), reactive nitrogen (nitrogen monoxide, nitrogen dioxide) and reactive chlorine (atomic chlorine). Being highly active oxidizing agents, free radicals act as cytotoxins, as they cause denaturation, binding and aggregation of proteins, as well as lipid oxidation with the formation of their peroxides.

Studies of recent years have shown that free radicals (FR) play a significant role in the pathogenesis of many diseases (bronchial asthma, pneumonia, complications of diabetes, cancer, etc.).

Violation of stationarity of free radical reactions is a universal, non-specific mechanism of pathogenesis, which underlies the development of a variety of pathologies. In principle, any organs and tissues can suffer from oxidative damage. Lungs are the most vulnerable in this regard, because they have physiologically incorporated an intensive course of free radical reactions. In addition, they are in direct contact with the molecular oxygen – the initiator of oxidation, as well as with oxidants contained in the air (oxidants of tobacco smoke, nitrogen dioxide, sulfur, dust, microorganisms, and many others).

Free radicals that damage cellular structures stimulate the process of atherosclerotic plaques formation in coronary and cerebral vessels, accelerating the processes of body aging, by increasing the processes

of lipids peroxidation and changes in the qualitative characteristics of lipoproteids with their accumulation in foam cells, which is the basis of atherosclerotic vascular impression.

The development of oxidative stress contributes to the emergence of endothelial dysfunction, causes an increase in the production of biologically active substances (endothelins), which increase the permeability of blood vessels, causing vasoconstriction. Endothelial dysfunction plays an important role in the development of coronary heart disease, in violation of blood circulation in various organs in patients with diabetes mellitus.

The consequence of «oxidative stress» is a violation of the rheological properties of the blood. Excess free radicals affect the state of the erythrocyte membranes, resulting in their deformation, changing the «fluidity» of the blood and osmotic resistance of red blood cells.

Excessive formation of free radicals violates hydrophobic bonds of macromolecules of the vascular wall, as well as Langerhans islands. In this case, there is a separation of oxidative phosphorylation, lysosome labization, which ultimately leads to a decrease in the synthesis of proinsulin and the death of β -cells. The metabolism of ω -6-fatty acids results in increased endothelin-I, angiotensin-II production, NO-synthetase activity inhibition, production of prostaglandin I₂, and promotes endothelial dysfunction, which leads to increased vasoconstriction and arteriovenous bypass grafting. The consequence of these changes is a decrease of capillaries blood flow.

The intensity of free radical reactions course in the human body is controlled by antioxidant defense system. In the normal state in the oxidants-antioxidants system is maintained equilibrium. Disturbance of this balance in favor of the increased generation of oxidants leads to the development of so-called «oxidant stress», which manifests itself in the excessive and long-term formation of a large number of active forms and the development of relative insufficiency of the antioxidant system due to the sequential attachment of electrons to molecular oxygen.

To date, one of the tasks of metabolic therapy is the inhibition of the oxidation of fatty acids and the prevention of their underoxidized forms formation, as well as the reduction of oxidative stress by stimulating the antioxidant enzymes activity and increasing the amount of natural antioxidants.

Antioxidant protection is realized through endogenous antioxidant systems, which include water and fat soluble antioxidant vitamins (alpha-tocopherol, beta-carotene, ascorbic acid, citric and

nicotinic acids) and their enzymes (superoxide dismutase, catalase, glutathione transferase, glutathione peroxidase, glutathione reductase) and trace elements (selenium, zinc, copper), interfering in various stages of anti-oxidant protection. These compounds form the basis of medications with antioxidant properties, which doctors recommend for use in various diseases, including diabetes. Antioxidant preparations include beta-carotene, alpha-tocopherol, glutamine, nicotine, α -lipoic acid, riboxin, and various complexes - Ricavit, Decamevit, Tri-Vi-Plus plus, etc.

Reduction of oxidative stress manifestations leads to less severe damage to mitochondria, cell membranes, and other organelles, to a greater degree of glycolysis with phosphorylation, an increase in the synthesis of AMP and a decrease in cell apoptosis.

However, with incorrect and exaggerated use of antioxidants, the negative effects of «oxidant stress» can be increased with the disruption of compensatory mechanisms to maintain the homeostasis of the organism.

Aerosol therapy of SOM is used for therapeutic purposes to accelerate the rehabilitation of patients with chronic complications, underlying the pathogenesis of which are metabolic changes, and with measures to prevent the exacerbation of these diabetes complications.

The following results were obtained with the use of SCS: improvement of rheological properties of blood, blood circulation of various tissues and organs, reduction of inflammatory processes and stimulation of regenerative, normalization of blood pressure and biochemical parameters (normalization of glycemia, increase of Hb, changes in lipid metabolism levels, decrease in fibrinogen and prothrombin levels index, lactic acid, urates, immune enhancement, etc.).The regimen of singlet-oxygen therapy in patients with diabetes is shown in Table 25.

Table 1.
The singlet-oxygen therapy regimen in diabetes mellitus.

Day of reatment	Morning inhalation, min	Evening inhalation, min	The amount of SOM for taking per os, ml
1	7	7	100
2-4	10	10	100
5-7	15	15	150
8-10	15	15	200
11-14	10	10	100

The course of treatment is 10-20 procedures, depending on the severity of the condition, the stage of the process and the age of the patients. For children under 12 years the number of procedures and volume of SOM cocktail is reduced by 30%. The duration of the procedure is 7-15 minutes.

When receiving SOM in some patients (0.7-1.2%) in the first 2-5 days may be a manifestation of increased detoxification: headache, sleep disturbances, discomfort in the intestine, etc. To prevent this it is recommended to increase the consumption of water up to 2-3 l, and in addition to take antioxidants, vitamins A, E, C and B, and trace elements: selenium, zinc, copper, especially elderly patients with diabetes. To eliminate these manifestations - reduce the exposure of each inhalation session for 1-2 minutes or the amount of activated water by 50 ml.

The control of the antioxidant defense status is determined by the number of anti-peroxide enzymes, which include superoxide dismutase (SOD), catalase, peroxidase, glutathione peroxidase, α -tocopherol, ceruloplasmin, whose level is significantly reduced in diseases, including those with diabetes, and evidence of oxidation inhibition -recoverable processes. SOD and catalase prevent the accumulation of superoxide and hydrogen peroxide in the cells; glutathione peroxidase catalyzes the reproduction of peroxides, hydrogen peroxide due to the oxidation of glutathione; α -tocopherol stops the reaction of peroxide oxidation of fatty acids.

Indicators of excessive formation of the amount of LPO products due to the increase of the oxygenase pathway of oxidation are diene conjugates (primary products of LPO), the level of which increases with DM, and the degree of oxidation of serum lipids. High glucose levels are

accompanied by an increase in the concentration of malondialdehyde in the blood plasma (secondary product of LPO).

The imbalance in the system of the LPO-AOS is determined by the coefficient of the given system indicators ratio by the special formula of Davydov B.V. and Golikova P.P. Indicators of the kinetics of lipid peroxidation processes may be the levels of individual lipid fractions: chylomicrons, pre- β -LP, α and β -lipoproteins, fractions of the phospholipid composition of erythrocytic membranes.

CONCLUSION

At the heart of the clinical effect of the singlet-oxygen mixture (SOM) is the restoration of the oxidation phosphorylation enzymes activity and antioxidant protection, normalization or reduction of lipid peroxidation excess activity (by levels of hydroperoxides), which reflect the degree of membrane destruction. The use of SOM promotes the improvement of rheological properties of blood and microcirculation, reducing hypercoagulation, activating energy processes in erythrocytes, and lowering blood glucose levels.

SOM can be recommended for use in the treatment of diabetes 1 and 2 types in inpatient and outpatient settings as a non-drug treatment in its complex therapy to reduce or normalize metabolic changes, which will serve to prevent the onset or progression of early and late complications of the disease.

6. ORGANIZATION OF PREVENTIVE AND HEALTHCARE ACTIONS FOR CHILDREN IN CONDITIONS OF GENERAL LEARNING EDUCATIONAL INSTITUTIONS

In recent years, the tendency of the children's health deterioration has been determined, which is due to the influence of various factors of biological, socioeconomic, ecological, medical and organizational nature on them.

According to statistical materials of the Ministry of Health of Ukraine, there is a tendency towards an increase in the overall incidence of children, an increase in the prevalence of chronic diseases and the level of childhood disability. Particular attention in this regard is needed for children of pre-school and school age.

Scientific researches of the Institute of Pediatrics, Obstetrics and Gynecology of the Academy of Medical Sciences on the state of health of these contingents in children showed that, when examining the children of seven preschool institutions in Kyiv preparing for school, only 22.7% of them were classified as healthy, and 51.7% of children had various chronic diseases.

Monitoring studies of the health of schoolchildren of 4 schools in Kyiv, which we conducted within the framework of the interagency integrated program «Health of the Nation», confirm the data of many authors about the deterioration of it during school years. The results of our research found that in 29.2% of children, functional deviations in the health state were detected, and 47.1% of schoolchildren had a chronic pathology. It was also noted that the increase in the level of chronic pathology from 39.5% in the first grades to 61.9% in the 11th grades.

According to our data, the first place among detected pathologies are diseases of the respiratory system (nasopharynx), digestive organs, disorders of the bone and muscular system, nervous and endocrine systems.

It is also noted the increase of diseases of the vision organs and deviations of the the heart and blood vessels healthy state.

In addition to somatic abnormalities in the health of children, we conducted a study of the functional capabilities of schoolchildren of the basic school number 70 in Kiev.

An important indicator, according to experts in hygiene, is the adaptive potential that characterizes the level of the cardiovascular

system functioning and reflects the balance between the organism and the environment. In this case, for the schoolchildren, the educational process should be considered as environment, from the organization of which the functional state of children depends on.

The conducted studies showed that only 10.4% of girls and 13.6% of boys had satisfactory adaptation, and 22.4% of girls and 14.3% of boys had unsatisfactory adaptation, besides, 56.0% of girls and 57.9% of boys had a tight adaptation.

Taking into account the increase of educational load on children, which often does not meet the physiological capabilities of them, we consider it necessary to draw the attention of school psychologists to the psychological state of schoolchildren.

The psychological testing of 803 pupils of school №70 in Kiev, according to the methodology of psychologist M. Luscher, made it possible to state that unsatisfactory psychological state was observed in 58.3% of junior pupils and 60.3% in middle classes.

We also paid attention to the physical health of children, which indicators characterize the physical preparedness of children. The assessment of these indicators shows that the reduced rates were noted in 30.5% of junior pupils, 56.5% - in the middle classes and 60.3% in the upper grades, which is related to the hypokinesia of children and the unsatisfactory organization of physical education.

As you know, in addition to school, children are affected by the conditions of their life and education in the family. The survey of parents of children of basic schools №34 and №70 in Kyiv showed that 27% of children are under-sleeping, 32.8% of children of junior high school, 45.9% of middle-aged children and 40% of older children are not in the open air, but only about 25% of children are engaged in physical education outside of school.

The existing health care system can not fully provide in-depth surveys of children at educational institutions and provide them with the necessary medical support. A school doctor is responsible for 2,500 children and mainly engaged in prophylactic vaccination, at the same time the rehabilitation of children with any health abnormalities relies on parents, the directors and pedagogical groups of schools are not involved in the health care programmes.

When analyzing the absence of students about the diseases in the basic school №70 of Kyiv, the number of passes was 11122 days for the academic year 2007-2008, among them 21.7% of children of junior classes, 30.1% of them were of secondary school, 23% senior grades.

Monitoring the health of children showed that during the academic year, the percentage of healthy children decreased from 27.2% to 18.8%, and the number of children with chronic pathology increased from 36.1% to 53.6%. The scientific researches on the assessment of the health status of children have led us to develop new approaches to improving their health in educational institutions.

Having discussed the problem of children health prevention with the directors of the basic schools and parent committees, it was decided to organize preventive and recreational activities for children in the educational establishment.

An important measure was the creation of a health-care cabinet in basic schools (No. 34 and No. 70 in Kyiv) equipped with physiotherapeutic equipment, in which nurses performed health treatments for children with different health disorders under the control of teachers. In addition, teachers were given recommendations on the fight against children's fatigue, and the teacher of physical education instructions for exercising depending on the functional capacity of children's body of different age groups.

Parents were given recommendations on the proper work and rest regimen for children.

Much attention was paid to the physical education and children's motor activity. For this purpose, in primary schools the number of hours of physical education lessons was increased up to three per week, reestablished physical education minutes in general education lessons, outdoor breaks were recommended. The introduction of preventive and strengthening measures in educational institutions is a promising direction, which makes it possible not to discourage children from learning and parents from work.

The methodical recommendations intended for medical staff of children's polyclinics and educational establishments, for directories and pedagogical staff of schools.

1. Application of singlet-oxygen therapy in the conditions of educational institutions.

The singlet-oxygen method of therapy was proposed in 1996 by the Swedish scientist Anthony Wang as an alternative method of antioxidant protection. Activation of oxygen occurs due to exposure to ultraviolet irradiation. Activated oxygen lives for a short time and then goes into its normal state. The process of the singlet-triplet transition is accompanied by the radiation of ultraviolet waves, which activate the link of biochemical and biophysical processes aimed at the

normalization of the metabolic-oxidative reactions of the organism. Over the years, the method has proven well in various clinics in Europe, America and the CIS.

The singlet oxygen we used to rehabilitate children at school was obtained using the device MIT-S (patents for the utility model of Ukraine No.33892, No. 1395, patent for utility model number 841644) using ultraviolet and quasi-laser radiation and double magnetic processing.

The singlet-oxygen mixture is a mist, which includes, in addition to singlet oxygen (1O_2), water vapor, nitrogen oxide (NO) and air. We used a method of structuring water for the preparation of singlet-oxygen foams. The consumption of solutions took place immediately after cooking.

The method is appropriate to be used at:

1. General and recreational measures for schoolchildren, according to the schedule - four courses during the school year, 10 sessions per course, as well as during periods of seasonal risk of acute respiratory and viral diseases.
2. Pathology of the respiratory organs without decompensation and in the period beyond the exacerbation;
3. Diseases of the digestive system;
4. Fatigue, nervous and asthenic conditions of the child;
5. Diseases of the musculoskeletal system (scoliosis, osteochondrosis).
6. Diseases of internal secretion organs.

The effectiveness of singlet-oxygen therapy is evidenced by scientific research conducted by the Institute of Pediatrics, Obstetrics and Gynecology for the rehabilitation of children with chronic diseases of the upper respiratory tract in basic schools. The aforementioned procedures were carried out with the device for preparation of a singlet-oxygen mixtures «MIT-S». Singlet-oxygen mixtures should be used in accordance with clause 4.1 of this section or the recommendations of the physician.

Consumption of singlet-oxygen cocktails for 10 days made it possible to significantly reduce the amount of pathogenic microflora in the nasopharynx, increase the level of normal microflora and reduce the activity of the inflammatory process. As a result of this method application, there was a general improvement in the health of children, reduction of acute morbidity, normalization of bacterial microflora in

children with chronic tonsillitis, «restoration» of the microbiocenosis of the nasopharynx, improvement of progress, decrease in the level of neurotic and depressive states.

Thus, the number of pathogenic staphylococci in the nasopharynx decreased from 53.1% to 3.1%, streptococci from 21.9% to 0%. At the same time there is a significant increase in the number of lactobacilli. (Materials published in the journal Perinatology and Pediatrics .- 2007.- No. 4). SOT should become one of the basic methods for improving children's lives in organized groups. Singlet-oxygen mixtures are the enriched with singlet oxygen inhalations, cocktails prepared on the basis of table bottled and mineral water, phytochemicals, juices, vegetable syrups.

Contraindications for using the method: Not detected.

For disinfection measures during singlet-oxygen therapy, masks, mouthpieces, sprayers, which connect elements and cups of all types of apparatus, must be washed with flowing water with detergent and placed in one of the means of disinfection, which has a permit for use.

The use of techniques that meet the requirements of bioethics and regulatory documents of the Ministry of Health of Ukraine is allowed.

6.1. Indications for the use of singlet-oxygen therapy and the procedure for conducting procedures

1. Health improvement.

Course: 20-25 sessions.

Frequency: 4 courses during the school year with a break between courses of at least 1 month.

Procedure: foam.

Juice-based foam. Junior grades - 150 ml, senior grades - 200 ml per reception.

Herbal collection: hips, hogs, nettles, wheat germs, rhodiola, echinacea.

Time: 1.5 hours after meals.

2. Diseases of respiratory system.

Course: 15-20 sessions.

Frequency: 5 courses during the school year with 1 month break between courses.

Procedure: Inhalation + Cocktail or Foam.

Inhalation duration: Junior grades - 5 minutes, Senior grades - 7 minutes.

Cocktail with bronchopulmonary herbs collection. Junior grades - 100 ml, senior grades 150 ml per session.

Time to satiate the cocktail: 100 ml - 3 minutes, 150 ml - 5 minutes.

Foam based on juice or foam based on herb solution (70% juice + 30% tea based on herbs solutions).

Junior grades - 100 ml, senior grades - 150 ml per reception.
Herbs-mixture: Eucalyptus, Althaea, Viburnum, Fennel, thyme, three-color violet.

Time: 1.5 hours before lunch.

3. Diseases of Digestive system.

Course: 20 sessions, 5 procedures with a two-day break.

Frequency: 2 courses during the school year, preferably in September and March.

Procedure: cocktail or foam.

Cocktail. Junior grades - 150 ml, senior grades 200 ml per session.

Time to saturate the cocktail: 150 ml - 5 minutes, 200 ml - 7 minutes.

To prepare a cocktail is better to use chloride-sodium non-carbonated mineral water or solutions of gastrointestinal herbs .

Herbal foam (70% juice + 30% tea based on herbal plants solutions).

Junior grades - 150 ml, senior grades - 200 ml per session.

Herbal collection: Ayr, flax, linden, thistle spot, mint, chamomile.

Time: 1 hour before or 1.5 hours after meals.

4. Fatigue

Course: 20-30 sessions.

Frequency: 4 courses during the school year.

Procedure: inhalation + foam or phyto-foam.

Inhalation Duration: Junior grades - 5 minutes, Senior grades - 7 minutes.

Foam based on juice with added vitamin C. Younger grades of 150 ml, senior 200 ml per session.

Phyto foam (70% + 30% juice from herbal tea). Junior grades - 150 ml, senior grades 200 ml per session.

Herbal collection: Lemongrass, levince, arnica, green tea, rhodiola.

Time: in the morning, 1-1.5 hours after breakfast.

5. Diseases of the bone and muscles system and the connective tissue.

Course: 20-25 sessions.

Frequency: 2 courses during the school year, preferably in Spring and Autumn.

Procedure: inhalation alternate with a foam every other day.

Inhalation duration: Junior grades - 5 minutes, Senior grades - 7 minutes.

Juice-based foam. Junior grades - 150 ml, senior grades - 200 ml per session.

Herbal collection: ginger, gazelle, cranberries, field horsetail.

Time: 1.5 hours after meals.

6. Diseases of the organs of internal secretion.

Course: 15-20 sessions.

Frequency: 3-4 courses during the school year (preferably: end of November - beginning of December, end of February - beginning of March, end of May - beginning of June).

Procedure: cocktail or foam.

Cocktail with herbal solution. Junior grades - 100 ml, senior grades - 150 ml per session.

Herbal collection: plantain, timpani, corn meadows, chicory, blueberries.

Time to satiate the cocktail: 100 ml - 3 minutes, 150 ml - 5 minutes.

Herbal faom (70% juice + 30% tea based on herbal solution). Junior grades - 100 ml, seniorgrades - 150 ml per session.

Time: 1 hour before meal.

7. REGULATIONS ON THE SINGLET OXYGEN THERAPY ROOM AND APPARATUS FOR ITS IMPLEMENTATION

7.1. General regulations.

7.1.1. The singlet-oxygen therapy cabinet is a structural unit of a medical or health institution that must provide all the necessary volume of this type of prevention or treatment to patients.

7.1.2. The activity of the singlet-oxygen therapy cabinet is regulated by the orders of the Ministry of Health.

7.1.3. The opening and closing of the cabinet is carried out in accordance with the established procedure.

7.1.4. The staffing table of the cabinet is approved as part of the general staffing table of the institution.

7.1.5. The singlet-oxygen therapy cabinet is located in a specially equipped for this purpose room or general inhalator, which must fully meet the requirements of operation and safety.

7.1.6. The cabinet is equipped according to the table and taking into account the profile of the medical or preventive institution.

7.1.7. The management of the office is carried out by the head of the department or physician-physiotherapist, and in their absence, by a senior doctor or a clinician who has education in physiotherapy.

7.1.8. Singlet-oxygen therapy is one of the new methods of modern device physiotherapy and its application in sanatoriums should cover not less than 85% of patients staying at resorts.

7.1.9. The work of the cabinet is carried out according to the schedule approved by the head physician (director) of the institution.

7.1.10. Normative loads of nurses are supervised by the head of the department or physician, and they must comply with existing orders.

7.1.11. Requirements for medical personnel who work in the cabinets of singlet-oxygen therapy are regulated by the order of the Ministry of Health No. 15 of 26.01.2005.

7.2. The main tasks of medical personnel in the cabinets of singlet-oxygen therapy.

7.2.1. Provide rehabilitation and medical rehabilitation of patients with different methods of treatment with adequate methods of singlet-oxygen therapy at the treatment and preventive stage:

- inhalation of singlet-oxygen mixture;
- consumption of activated liquids, mineral water, phyto-teas, etc., activated by a singlet-oxygen mixture;
- rinsing the mouth, washing tonsils and other manipulations (lubrication, moist compresses on the oral mucosa) with a singlet-oxygen mixture;
- special techniques for singlet-oxygen therapy - intramuscular or intra-vaginal irrigation, etc.

7.2.2. To introduce and develop new methods of singlet oxygen therapy depending on the profile of the treatment, rehabilitation department or the age group of health-improving ones.

7.2.3. Perform a control (performed by a doctor) for the performance of the prescribed inhalation procedures with a singlet-oxygen mixture and an analysis of the errors in carrying out the procedures by the average medical personnel.

7.2.4. Systematically conduct an analysis of the quality of the cabinet.

7.2.5. All the medical staff of the department (office) must improve their qualifications.

7.3. The order of sending patients and vacationers to the singlet-oxygen therapy room

7.3.1. Patients are sent to the room for singlet-oxygen therapy after preliminary medical examination and with mandatory measurement of blood pressure and pulse counting.

7.3.2. The singlet-oxygen therapy can be prescribed only by physician.

7.3.3. The doctor who sent the patient to singlet-oxygen therapy, can only recommend one or another procedure, and the physiotherapist of the cabinet has the right to prescribe another, more adequate (effective) method of treatment.

7.4. Basic indications for singlet-oxygen therapy

7.4.1. Diseases of the respiratory system without decompensation and without exacerbation.

7.4.2. Pathology of the digestive system.

7.4.3. Diseases of the central nervous system without decompensation of the process or gradation in terms of severity:

- residual phenomena;
- light or moderate severity.

The CNS diseases to be treated with singlet-oxygen therapy are:

- consequences of inflammatory diseases of the brain and spinal cord and injuries;
- consequences of stroke, etc.

7.4.4. Diseases of the peripheral nervous system with pain manifestations, trophic disorders, etc.

7.4.5. Diseases of the musculoskeletal system.

7.4.6. Diseases of endocrine glands, including diabetes mellitus.

7.4.7. Functional disorders of the nervous system.

7.4.8. Singlet-oxygen therapy has a wide application in cosmetology and for health purposes.

The following are recommendations for the use of singlet oxygen therapy with proven therapeutic effect.

Pulmonology:

- tuberculosis of the bronchopulmonary system,
- tuberculous intoxication,
- chronic relapsing and obstructive bronchitis,
- asthmatic bronchitis, occupational diseases of the respiratory system,
- acute poisoning with toxic gases,
- emphysema of the lungs,
- bronchial asthma,
- pharyngitis.

Cardiology:

- hypertension of 1-2 degrees,
- stable angina pectoris of 2-3 functional class,
- functional cardiopathy,
- postinfarction,
- rheumatism with secondary immunodeficiency syndrome,
- IHD,
- atherosclerotic cardiosclerosis with arterial hypertension,
- VVD according to the hypertonic type,
- varicose veins and thrombophlebitis.

Gastroenterology:

- chronic gastritis, gastroduodenitis,
- peptic ulcer of 12 duodenum,
- leukemia.

Endocrinology:

- diabetes,
- obesity 1 and 2 degrees,

- chronic fatigue.

Neurology:

- encephalopathy,
- cerebrovascular pathology,
- VVD,
- neuroses, asthenic conditions,
- diencephalic syndrome.

Traumatology and orthopedics:

- osteochondrosis,
- post-traumatic bone injuries,
- Bechterew's disease.

Dermatology:

- eczema,
- neurodermatitis,
- trophic ulcers.

Immunology:

- secondary immunodeficiency conditions (infectious, allergic),
- allergies.

Infectious diseases:

- hepatitis,
- diphtheria and meningococcal bacteriocarrier,
- acute rhinopharyngolaringitis,
- acute and chronic tonsillitis,
- acute intestinal infections.

Surgery:

- burn disease,
- postoperative period,
- oncological diseases.

Radiology:

- rehabilitation of liquidators of consequences of accidents at the Chernobyl NPP.

Nephrology, urology:

- kidney disease,
- diseases of the bladder and urinary tract.

Obstetrics and gynecology:

- rehabilitation of women in different periods of pregnancy,
- diseases of the female sexual sphere.

Gerontology:

- age-related diseases,
- recovery.

Sports medicine:

- adaptation of athletes to competitions,
- after competition recovery period.

SOT effects

The results of the singlet-oxygen therapy application, consisting of 12-24 sessions, are the subsequent processes that occur in the human body:

- detoxification of the body;
- restoration of the antioxidant state;
- normalization of cell membrane potential and bioenergetic status of cells;
- stimulation of metabolic and regenerative processes in tissues, a decrease in the activity of inflammatory phenomena;
- normalization of external respiration functions, improvement of tissue respiration and reduction of hypoxia;
- «renewal» of bronchial mucosa and resorption of infiltrates in the lungs;
- improvement of sputum discharge and relief of asthma attacks;
- «withdrawal» from hormone therapy in hormone-dependent patients;
- improvement of cerebral and peripheral circulation;
- stabilization of blood pressure;
- optimization of metabolic processes at physical loads, improvement of oxygen uptake by tissues;
- increase the body's defenses and reduce the risk of infection;
- improvement of rheological properties of blood;
- a decrease of the lactic acid levels in muscles and the content of urate in the blood serum;
- positive changes in the ECG dynamics;
- decrease of prothrombin index, fibrinogen level and increase of clotting time in postinfarction patients;
- increased hemoglobin levels and reduced blood sugar levels to normal;
- normalization of the bilirubin, cholesterol, betalipoproteins and alkaline phosphatase levels;
- a decrease in the protease-destroying ability of neutrophils

and an increase in their bactericidal activity in secondary immunodeficiencies;

- immunomodulation of T- and B-systems of immunity and stimulation of secretory IgA;
- reduction of the body's sensitization to the tuberculosis antigen;
- a decrease in the level of radioactive cesium-137.

Basic contraindications for singlet oxygen therapy

Contraindications for carrying out of SOT include general contraindications for physiotherapy:

- malignant neoplasms;
- systemic blood diseases;
- acute general exhaustion of the patient (cachexia);
- stage III hypertension;
- severe atherosclerosis of cerebral vessels;
- diseases of the cardiovascular system in the stage of decompensation;
- bleeding or inclinations;
- the general severe condition of the patient;
- febrile state (patient body temperature above 38 ° C).

Besides:

- all diseases in the acute period, in particular severe forms of repeated pneumonia with common changes in the bronchopulmonary system, bronchiectasis with frequent exacerbations and with cardiopulmonary insufficiency;
- bronchial asthma 3 and 4 degrees of severity;
- diseases that require treatment in a hospital setting;
- infectious, parasitic diseases and contact with infectious patients before the end of the isolation period;
- all infectious and parasitic diseases of the skin and eyes, venereal diseases;
- amyloidosis of internal organs;
- bleeding, which is often repeated and with a large loss of blood, hemoptysis, pulmonary hemorrhage;
- pathological development of the individual with manifestations of deviant behavior, social disadaptation, mental retardation, which require individual care and treatment in a specialized hospital;
- acute mental disorders.

However, it should be emphasized that even in a very serious condition, the patient can be inhaled with a singlet-oxygen mixture or

consume the liquid per os activated with singlet-oxygen mixture. Such studies are being conducted, and their results will become known in the near future. The above contraindications for singlet-oxygen therapy are relative.

8. THE METHOD OF EDGE ANXIETY-DEPRESSIVE DISORDER CORRECTION IN PATIENTS WITH DIABETES MELLITUS

According to the statement of Mr. Deborah Wan, President of the World Federation for Mental Health "Depression is one of the most common diseases, often combined with other serious illnesses. According to the World Health Organization, unipolar depressive disorders estimated as the third leading cause of the global burden of disease in 2004, which by 2030 will have undisputed leadership. Unfortunately, the global crisis, lack of exercise and powerful energy-effects led to an increase in uncertainty about the future, and this in turn led to an increase in the number of people with a depressive state of the population in most developed countries. In 2012, the world depression affected about 350 million people - about 5% of the world population, and by 2020 this figure will almost double."

Therefore, it is obvious that the development of effective prevention technologies and rehabilitation of mental and behavioral disorders is one of the most important tasks of modern psychiatry and clinical psychology, which will not only reduce the cost of treatment of this disease, but also improve the quality of life in patients with type 2 diabetes.

Creating effective way to medical treatment of anxiety-depressive edge disorders in patients with type 2 diabetes should be based on a variety of factors contributing to the emergence of this disease and the impact on their course, prognosis and determine their reaction to the proposed treatment. Additionally, you must take into account the fact that this group of diseases is systemic, and thus a method of treatment should be based on a system of multi-level and multi-factorial approach.

According to ICD-10 depressive disorder refers to classes F32-F39, F92. Possible to determine the level of depression in patients with type 2 diabetes, we used the symptoms of depression test ICD-10:

- A bad mood, depression, debilitating condition, decadent thoughts, sadness, "bored in my soul", "all gray".
- No activity at work, decreased performance, procrastination, violation of pre-scheduled dates, everything becomes a "do not care", lack of joy.
- Fatigue once sat down to work after the work has been for nothing

strong enough, the feeling of constant fatigue, unwillingness to entertainment.

- Additional symptoms: impossible to concentrate on the starts work and action, and there are distracting irritants, the emergence of parallel thinking, decreased attention.
- Indecision not previously available in all types of cases, the lack of self-confidence.
- A critical evaluation of past life, emphasizing the negative factors, the painful feeling of "burden" in the family or at work.
- Gloomy thoughts of bankruptcy, finish, score themselves as losers, a sense of service life, and grim vision of the future.
- Sleep disorders - drowsiness, insomnia, sleep long, heavy awakening, lack of sense of relaxation.
- Decreased appetite.

If a patient diagnosed two depressive symptoms, it is easy depressive disorder; moderate depressive disorder with a subjective choice of 3-4 symptoms; if the patient has more than 4 symptoms, it is major depression.

To develop an effective depression treatment technology for second type diabetic patients, we had a full study in 2013 of the effectiveness of combined use of magnetic-therapy with individually selected frequencies of alpha rhythm in a comprehensive program of medical rehabilitation of diabetic patients with the syndrome of latent depression (T2D SLD).

Objective: to develop the technology and performance evaluation of psychological and medical rehabilitation of patients with type 2 diabetes mellitus (T2D) on the basis of magnetic laser therapy (MDT).

Objectives of the study:

1. Assessing clinical symptoms methods optimization, functional diagnostics and expert assessment of the level of latent depression in patients with T2D.

2. Development of technology and performance evaluation method of medical rehabilitation of patients with diabetes SLD by applying magnetic-therapy method developed by the authors.

3. Statistical data processing and evaluation of the medical rehabilitation effectiveness in patients with diabetes SLD based on the use magnet laser impact on the projection of the pancreas and the medulla oblongata.

Materials and Methods: in the period from January to December 2013, on the base of restorative treatment department of the Kiev City Hospital of Disabled WWII, we carried out studies to assess the effectiveness of magnetic-therapy in complex rehabilitation program for patients with type 2 diabetes. Patients in groups formed, so that the distribution of clinical manifestations, age and sex were approximately equal.

Type 2 diabetes was verified in accordance with the diagnostic criteria of WHO (1999) (T2D diagnosis was established by endocrinologists and studies conducted under their supervision). Analyzing the physical condition of patients, along with the type of diabetes, we took into account its duration and age of the patients. The results of laboratory and instrumental methods were evaluated. Body mass index – BMI was determined. The dynamics of subjective and objective clinical manifestations was considered as integral evaluation criteria of the patients.

For uniform distribution of patients into groups, we used the level assessment of latent depression tests recommended by prof. Samosyuk I.Z. et al. [2].

For research were formed 2 groups of patients of 30 people (34 women, 26 men, mean age - $62,0 \pm 13,3$ years): control group - were treated according to the guidelines [3] and the main group - were treated according to our method of simultaneous magnet laser impact on the projection of the medulla oblongata, and pancreas.

On the basis of clinical examination of 60 diabetic patients in 57.3% patients had depressive disorders: nosogenic depression (occurring on the type of anxiety and hypochondriacal depression - 34.2%) and dysthymia (like somatized depressive conditions 23.1%). In 42.7% of cases the affective (depressive) disorder were diagnosed. The grouping was almost uniform.

All patients diagnosed latent depression.

For the procedure was used the machine MIT-MT (SMC "Medintech", Kiev) with two magnet laser applicators with red spectral range ($0,67 \pm 0,02 \mu\text{m}$) and integrated optical power flow $35 \pm 5 \text{ mW}$ and the magnetic field of the southern pole of $22 \pm 4 \text{ mT}$. The duration of one procedure was 15 minutes. At the time of treatment for each patient were released 15 procedures. Procedures were released every other day.

During the procedure in the main group one magnet laser applicator (MLA) was placed on the pancreas head projection, the

second on a projection of the medulla oblongata (foramen magnum zone). Modulation of the magnetic field and optical flow executed synchronously. The choice of frequency was determined on the basis of individual choice in the range of the alpha rhythm (8-13 Hz) according to developed by prof. I.Z. Samosyuk methodic: 2 red MLAs were used to determine the frequency of individual therapy. One of them was placed on a projection of the medulla oblongata (foramen magnum zone), the second - on the projection of the frontal area of the maxillary sinus (1-2 cm above the bridge of the nose), the eyes of patients closed during the procedure. The initial modulation frequency was set 8 Hz and further growing at a 0.1 Hz to 13 Hz. Exposure time for each frequency was 5 ± 2 sec. Scanning frequency the patients experienced the change of psycho-physical sensations of color, type and size of geometric shapes. By polling subjective sensations the frequency at which the patient experienced a feeling of maximum comfort were determined, which is then were used for the procedure. In most patients it was $9,7\pm0,4$ Hz.

Results and discussion

Evaluation of treatment results was performed on the base of the evaluation of the dynamics of subjective and objective clinical manifestations in T2D patients (results are shown in Table 1) and evaluating the level of latent depression scale [2].

Table 1.

Dynamics of subjective and objective clinical manifestations in patients with T2D.

Monitoring groups		subjective manifestations		objective manifestations	
		Before treatment	After treatment	Before treatment	After treatment
1	Control (n=30)	15,81±1,4	11,8±0,9	8,65±0,51	7,2±0,46
2	Main (n=30)	15,39±1,62	8,6±0,8	9,4±0,58	6,1±0,42

Note: The probability of differences in comparison to before the start of treatment (p <0.05) on the criterion 2; p <0.01, 2criterion between the groups after treatment.

Positive outcomes were observed in all patients, both main and control groups. However, patients in the control group, the dynamics of subjective and objective clinical manifestations were on average 21.2% higher than the control. The number of diagnosed major depressive

symptoms in the intervention group decreased by 15.4% in the control to $7,2 \pm 1,3\%$.

Conclusions. Magnet laser therapy based on our proposed methodic, aimed at simultaneous stimulation of the pancreas and the medulla oblongata at the individually selected modulation frequencies optical stream of red spectrum and the magnetic field of the south pole has a more pronounced effect on the dynamics of subjective and objective clinical manifestations and the level of latent depression in patients with T2D.

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9. INTEGRATIVE APPROACH TO EXCESS WEIGHT REDUCTION

Psychosomatic diseases - a group of diseases in the etiology and pathogenesis of which, the decisive role is played by psychological causes or factors. According to WHO experts (2016), among all patients seeking treatment, the percentage of psychosomatic patients (F54)² ranges from 38% to 42%.

According to WHO experts (WHO Newsletter, June 2016), obesity (E66)² is one of the most common non-infectious chronic diseases in the world. In 2014, about two billion adults in the world were overweight or obese. Of which almost 30% had a body mass index of more than 30 units. This is the basis for the assertion that "excess weight" provokes one of the most massive non-infectious epidemics in the world. Most often, patients with excess weight are found in North America (USA, Mexico and Canada), the countries of the Persian Gulf (Saudi Arabia, United Arab Emirates, Egypt), Central Europe (Germany, Poland). The growth of the absolute number of overweight patients is dominated by the countries of Southeast Asia (China, India, Indonesia). It should also be noted that a steady increase in the number of cases of excess weight is observed in most countries of the world, regardless of the level of their economic development. In absolute terms over the past decade, the total number of overweight patients has increased by almost 75%. And, unfortunately, this trend will continue for the next decade. This will lead to the fact that by 2025 overweight and obesity will suffer at least 40% of men, 50% of women and about 30% of children.

Unfortunately, overweight and obesity affect not only the quality of life of patients and people with disabilities, but also the life expectancy of this group of patients. Average statistically, they live 8-10 years less than people with normal weight. From diseases provoked by excess weight, more than 2.5 million people die prematurely in the world every year (only in Europe 300 thousand and about 280 thousand in the USA). Total losses of the world economy from the "excess weight" of mankind are estimated at 2.1 trillion of USD annually.

As defined by WHO, overweight and obesity are the result of the formation of abnormal or excessive deposits that are harmful to health. For the diagnosis of overweight and obesity in adults, it is recommended to use the "Body Mass Index" (BMI - kg/m^2) - the ratio of body weight (in kilograms) to the square of the growth value (in meters). According

to the WHO experts recommendation, the diagnosis of "overweight" or "obesity" in adults is established with: BMI ≥ 25 - overweight and BMI ≥ 30 - obesity.

BMI is the most universal indicator for assessing overweight and obesity in a population, since it can be applied to all categories of people.

The increased value of BMI is one of the main risk factors for the development of the following diseases:

- cerebrovascular diseases (I60-I69);
- diabetes mellitus (E10-E14);
- some diseases of the musculoskeletal system and connective tissue (M00-M99);
- mood disorders (F30-F39).

Objective. To develop a method of reducing excess weight on the basis of an integrative approach.

Materials and methods. 72 clients of the center of cosmetology psychology "A+A" (Kiev) aged from 26 to 47 years took part in the study, having BMI of 27.3 ± 1.9 and giving voluntary consent to participate in the experiment of weight loss based on the use of zone magneto-roller massage [1] in 2017. Only women participated in the study. All women before testing and after 10 procedures were tested for the level of depression in the psychometric tables of A. Beck and the level of anxiety according to Spielberger-Khanin tables, weighing and definition of BMI. Study participants were randomly divided into 3 groups of 24 people.

In the first group, weight correction procedures were performed with the use of the apparatus MVT-01 and the magneto-roller nozzle [2]. The level of local depletion in the magnetic roller head was 0.6 ± 0.8 atm., the procedure time per zone was 5 minutes, in total up to 30 per customer. For the course were prescribed 10 procedures, which were conducted every other day. In addition, before the procedure of magnetic massaging, the clients took 100 ml. of rose hips broth and 1 tablet of aspirin. The main objective of the procedure was to improve blood microcirculation in the area of increased adipose tissue and lymph drainage. An example of the magnetic vacuum massage procedure is shown in Fig. 7.



Fig. 7. Example of the procedure of magnetic-roller vacuum massage.

In the second group, in addition to the first group, a functional correction of liver function was performed by the method of magnetic laser stimulation of the liver with the use of the apparatus MIT-MT. The optical flux of the red magnetic laser applicator was 50 ± 10 mW, the induction of the magnetic field was 25 ± 5 mT. The applicator was placed on the projection zone of the liver (right hypochondrium). The optical flux of the infrared magnetolaser applicator was 70 ± 15 mW, the magnetic field induction was 25 ± 5 mT. The applicator was placed on the zone of the large occipital orifice. The frequency of modulation of the optical flux and the magnetic field was determined on the basis of the Samosyuk-Chukhraiev method [3,4]. At the majority of clients it was 9.7 ± 1.5 Hz. Procedures were carried out after the procedure of vacuum magnetic-roller massage. The procedure time was 15 minutes. An example of the correction procedure is shown in Fig.8.



Figure 8. Determination of the modulation frequency of the optical flux and the magnetic field (according to the Samosyuk-Chukhraiev method).

In the third group in addition, compared with the second group, psychological correction was performed using binaural beats. On the right side, the base frequency was set for the normalization of fat metabolism. It corresponded to 465 Hz [5]. On the left side we applied a frequency equal to the sum of the base frequency and the individually selected frequency of the modulation shift in the alpha-rhythm range of the cerebral cortex. The frequency was selected on the basis of the Samosyuk-Chukhraiev method, which for most customers was 9.6 ± 1.6 Hz. The endonasal respiration of the singlet-oxygen mixture in a magnetic field was performed using the MIT-C apparatus [6] using the patented technique [7,8]. The singlet-oxygen mixture with endonasal breathing provided the saturation of blood with active oxygen and compensated the lack of oxidant in the biochemical reaction, reduced the level of formation of free radicals, reduced the level of intoxication of the body. Applying the action of the magnetic field on the sinuses of the nose at the moment of endonasal breathing increases the saturation of the blood with active oxygen, increases fluidity of the blood, enhances the capillary effect, and increases the oxygen capacity of the blood. The remaining parameters were similar, as for the second group. Procedures were performed after the procedure of magneto-laser correction of liver function. The time of one procedure was 30 minutes. An example of the

psychological correction procedure with the use of binaural beats and the endonasal breathing of singlet-oxygen mixture in a magnetic field is shown in Fig. 9.



Figure 9. Example of the procedure of psychological correction.

Results and discussion. All clients who participated in the study had weight loss, improved turgor and skin color, mood, lowered the depression and anxiety level according to the psychometric tables of A. Beck and Spielberger-Khanin after the procedures, respectively. Negative effects of procedures were not recorded. All patients were happy to participate in the testing and subsequent discussion of psychological problems. The most active were the clients of the 3-d group. Almost all clients wanted to participate in psychological correction. Individual selection of parameters of magneto-laser stimulation caused an additional positive reaction in almost all clients of group 3. The results of determining the BMI and the psychological state of the clients who participated in the study are shown in Fig. 10 - Fig. 12.

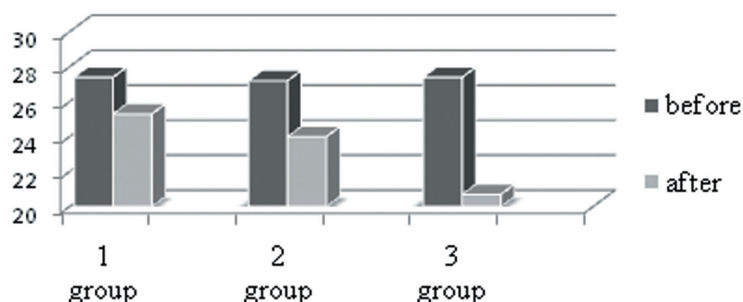


Fig. 10. BMI change before and after the procedure

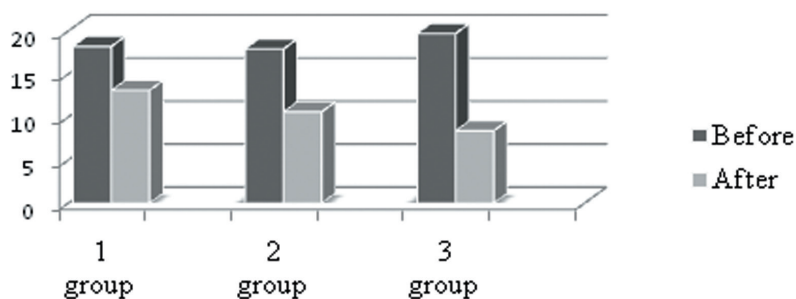


Fig. 11. The change in the level of depression in clients of groups 1-3 as a result of the procedures (according to A.Beck's scale)

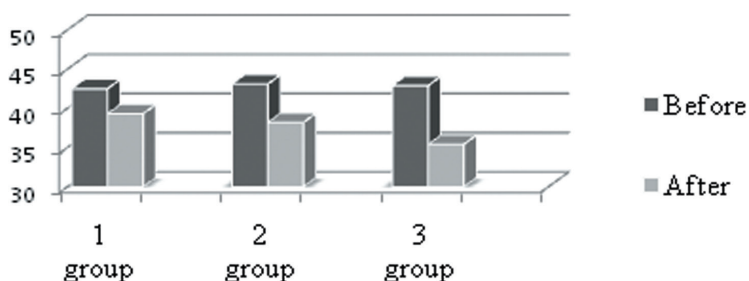


Fig. 12. Change in the level of anxiety among the clients of groups 1-3 as a result of the procedures (according to the Spielberger-Khanin scale)

Conclusions. Based on the results of the study, the values of BMI in the patients who participated in the study in the first group before the exposure was 27.4 ± 1.6 after 7 procedures 25.3 ± 1.5 , in the second group 27.2 ± 1.7 and 24.0 ± 1.3 , respectively, in the third group 27.4 ± 2.0 and 20.7 ± 1.1 . Psychological testing using the psychometric tables of A. Beck and Spielberger-Khanin showed a decrease in the average level of depression after the procedures in the first group by 5.1 ± 1.4 points, the level of anxiety by 3.2 ± 0.3 , in the second group by 7.3 ± 1.5 and 3.5 ± 0.4 , respectively, in the third group by 11.3 ± 1.9 and 7.5 ± 0.7 . In addition, it should be noted that the clients of the third group were more interested in conducting a second course.

The integrative approach to the reduction of excess weight on the basis of the application of zonal effect on the system of microcirculation of blood and lymph by the method of magnetic roller vacuum massage, stimulation of fat metabolism, due to the magnetolaser effect on the projection of the liver and medulla oblongata and correction of the psychological state on the basis of individually selected binaural rhythms in combination with endonasal breathing of a singlet-oxygen mixture in a magnetic field turned out to be the most effective.

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MACHINES FOR SINGLET-OXYGEN THERAPY

The Scientific and Methodological Center «Medinteh» produces several versions of singlet-oxygen therapy machine «MIT-S» (Patent of Ukraine No. 1395 «Machine for singlet-oxygen mixture preparation», September 16, 2002, Bulletin No. 9, 2002. Patent of Ukraine No. 33892 «Machine for singlet-oxygen mixture preparation», 10.07.2008, Patent of Russia No. 81644 «Machine for singlet-oxygen mixture preparation», 27.03.2009).



Fig.1. Machine MIT-S for singlet-oxygen mixture preparation.

Specifications

1. The maximum value of the magnetic induction, mTl 20;
2. Total power of optical flow activator, W 4;
3. Number of channels, pcs. 2;
4. Operating mode continuous;
5. The volume of the mixture to be created in 1 minute, l 2x7;
6. The volume of filled distilled water, ml..... 2x25;
7. Time of one procedure, min 1-9;
8. Supply voltage..... 220 V , 50 Hz;
9. Power consumption no more than, W 25;
10. Weight not more, kg 3;
11. Overall dimensions, cm 30x25x8;
12. Warranty period of operation, months.....12;
13. Technical service life, months.....120.

Machine description

The machine MIT-S consists of an electronic unit, two flasks for the preparation of a steam-and-water mixture, silicone tubes, atomizers, and inhalation tips. The housing of the electronic unit is made of impact-resistant polystyrene and consists of an upper cover

and a base, connected by four screws, a front panel and two rear plugs.

On the upper cover of the electronic unit are located: ventilation grille, two seats for steam-water mixture preparation flasks installation and four fittings:

- the first channel output from the compressor (blue);
- the first channel entry to the activator (green);
- the second channel activator entry (green);
- the second channel air outlet from the compressor (blue).

The flask for preparing the steam-water mixture consists of a bottom and an upper cup, which are connected to each other through a rubber gasket. Inside the bulb, a silicone tube with an atomiser on the end is installed. In the upper part of the bulb there are two connecting joints. One connection for supplying air from the compressor outlet (it has a continuation inside the bulb). The second connector is intended for connecting a silicone tube and supplying the steam-water mixture to the activator input.

On the basis of the electronic unit there are: ventilation grille and four instrument legs for suppressing vibration.

The 2-channel machine MIT-S for singlet-oxygen foam preparation



Fig.2 The 2-channel MIT-S machine for singlet-oxygen foam preparation

Specifications

1. Number of channels, pieces2;
2. The volume of the singlet-oxygen foam created apparatus for 1 min, no less, l1,5³;
3. Volume of singlet-oxygen foam created by the apparatus from 800 ml solution with one channel, portions..... 35-40⁴;
4. The volume of purified or distilled water poured into a flask for preparation of a steam-water mixture, ml 2x (30-35);
5. The volume of the solution, poured into the flask for the preparation of singlet-oxygen foams, is not more than, ml800;
6. Power consumption of the apparatus, not more than, Br 70;
7. Mass of the electronic block, not more than, kg13;
8. Mass of the device in the delivery set, not more than, kg15;

3 The degree of clamping the felt in atomisers affects the density of foam and the rate of foaming. With increasing the compression, the density of foam rises, the rate of foaming decreases. The primary installations of the manufacturer provide a foam rate of 1.5 ± 0.5 l / min

4 The number of servings (1 portion - 200 ml) is obtained from 600 ml of juice, 200 ml of herbal solution and 2-3 teaspoons of licorice root syrup (according to the methodical recommendations).

9. Overall dimensions, mm:
 - Electronic block 650x430x270 ;
 - electronic block with flasks for steam-and-water mixture 650x430x480;
10. Operational lifetime, h 1000;
11. Average service life of the device, not less than, years 5;
12. The device operates from a network of alternating current at a frequency of 50 Hz with a voltage of 220 V.

The single-channel machine MIT-S for singlet-oxygen mixtures preparation



Fig.3 The single-channel machine MIT-S for singlet-oxygen mixtures preparation

Specifications

1. Number of channels, pcs 1;
2. Volume of created mixture in one minute, l 3;
3. Volume of flooded purified water, ml 25;
4. Time of one procedure, min 1, 3, 5, 7, 9, 15;
5. Supply voltage 12 V, 3 A;
6. Power consumption, not more than, W 36;
7. Shipping weight, not more than, kg 4;
8. Overall dimensions of the machine, mm 240x225x115;
9. Operational lifetime, 5000 cycles;
10. Average service life of the machine, not less than, years 5.

THE EQUIPMENT OF SMC "MEDINTECH"

The vortex foot bath «KUPAVA»



The basis of the action of whirlpool bath is a combination of different strength of thermal, mechanical, optical and magnetic stimuli. When using the mineral water they are joined by chemical irritation due to the complex range of different mineral salts, gases and microelements.

Additionally is performed «Jet massage.» In this case the air is mixed with the water that circulate under the influence of the electric pump, and thus achieved a special vortex effect, known as the «Venturi tube». The jets of water and air coming from the nozzles located at the sides of the bath, intensively influencing on thy extremities.

Common effects after using vortex foot bath:

- reduction of physical fatigue, exhaustion, increase working capacity and efficiency;
- improvement of the central and autonomic nervous system;
- metabolism improvement;

The main indications: neuroses; insomnia, chronic fatigue syndrome; obesity; osteoarthritis of the joints; post-traumatic disorders of the musculoskeletal system (conditions after fractures, sprains and other injuries.); vascular dystonia; pelvic inflammatory disease is acute; impotence, diseases of the cardiovascular system. Women vortex foot

massage is a preventive measure against violations of the menstrual cycle.

Contraindications: TB and neoplastic bone lesions, acute trauma, fractures, burns.

"The system of rejuvenation, prevention and rehabilitation of the body based on low-intensity resonance therapy "

*Youth and health can not be returned,
but there is a chance to keep them as long as possible.*

Health is the precious gift of God, which a man spends so recklessly. Everyone understands that the future of each Arab family and the state as a whole depends on the level of health and intellectual development of the citizens.

The "System of rejuvenation, prevention and rehabilitation of the body on the basis of low-intensity resonance therapy," hereinafter referred to as the project is developed on the basis of need to rejuvenate the body, which will create conditions for the reduction of morbidity and increased longevity of the active citizens in developed countries. The project is designed for large-scale implementation in the territory of the Republic of Kazakhstan and the most developed countries.

The main focus of the project is the organization of production, sales and service of the system of recording, analysis, storage, providing the organization of control of health, rejuvenation, prevention, rehabilitation and treatment of various diseases on the basis of an electronic copy of healthy, young body.

The essence of the proposed system is as follows

Seven years ago, a group of German, Ukrainian, Russian and Kazakh scientists, led by Professor Samosiuk I.Z. and Chuhraiev N.V. started to work on a project evaluating the functional state of the organism based on processing the electrical signals picked up from the human skin at certain points. In fact, our work is based on the experience of traditional Chinese medicine, the Japanese school electropunctural measurements (I. Nakatani, etc.), the works of Dr. Voll and his followers (Germany), Basic Research under the Soviet-Russian school (Vorgalik, Nechushkin, Luvsan, Gotovsky, and etc.), the works of Helen Clark and a huge number of scientists around the world who have worked and continue working in the field of energy-diagnosis systems and therapy. As a result of many years of research we have found:

1. With aging of the individual are changed the parameters of:
 - bio-potentials generated by the cell during its operation;
 - electro dermal resistance of reflex zones;
 - Ph and EC of interstitial fluid;
 - electrical signals that control the operation of the functional systems of the body.

If we set the electrical signals generated by processing the prerecorded biopotentials of the chosen zone onto reflex zones, it is possible to achieve the restoration of the functional systems of the body to a level closer to the level at the state memory, ie perform body rejuvenation. These signals are restored younger rhythm of the bodies and the regular use of such a procedure slows down the aging process.

If you experience fatigue, stress or nervous disorders, the parameters of relevant functional systems change. This in turn affects the electrical parameters of the signal taken from the human skin in certain areas. Definition and classification of these parameters is an information component of the process of diagnosis and decision on the need and the correction parameters of the affected functional systems.

If we apply the electrical signals on certain points on the skin of the person (which were recorded in a healthy condition of the body) the restoration of a functional system and organ, respectively takes place. These signals regenerate a healthy rhythm of the organs and the regular use of such procedure brings a rapid recovery from many diseases.

Our many years of research and development were implemented in the proposed system of "WIT-A." The advantage of the developed system is a high efficiency and adaptability and what is very important – ability to learn.

The work of "WIT-A" is based on the possibility of recovering the parameters of different functional systems and organs based on previously recorded copies of the electrical signal with the use of multi-factor and multi-level effects on the basis of low-level resonance therapy.

On the particular elements of this system we have received more than 15 patents of Ukraine and Russia. Currently we are preparing materials for more than 5 patents on another particular units and patenting system as a whole.

The picture of external appearance is presented on the next figure:



The relevance of developing and adopting the project

Most modern diseases arise and develop on the background of development of the scientific and technical progress of the leading countries of the world. Many diseases are diagnosed and effectively treated with existing methods of pharmacological and physical therapy. However, there are quite a large group of diseases the treatment of which is based on the need for energy-correction of certain functional systems. This is due to the following reasons:

1. The increase of energy-load and physical activity reduction.
2. Environmental degradation due to higher levels of electromagnetic smog and harmful effects of mobile communications.
3. The decrease of the natural food in the traditional diet of the inhabitants of the region (without the use of preservatives and genetically modified ingredients).
4. Use of restructured water for drinking (canned carbon dioxide, chlorine or toughly filtrated without restoring the components of energy-water parameters).
5. High moral and psychological tensions in society and the family in connection with the need for labor migration and rupture in some family ties (separation of parents, children and grandchildren).

To maintain health and prolong active longevity should systematically test the status of functional systems and if necessary,

perform the correction of their condition by using the five basic principles:

1. Formation of an adequate control action on the principles of low-intensity resonance energy-signal.
2. Optimization of the parameters of conductivity data transmission system - improving the innervation of the skin and the excitability of nerve endings.
3. Improvement of microcirculation of blood, lymph and interstitial fluid in a functional system with modified parameters.
4. Activation of the efferent system.
5. Providing power to the system at all levels (water, biological, chemical and energy).

Modern energy technologies allow carrying out this in the most effective way, a new level of understanding of the functioning and management of biological systems and the development of microelectronics.

The system of rejuvenation, healing, prevention and medical rehabilitation WIT-A is implemented on the basis of automated hardware-software complex, which includes elements of the body and the Internet-based medicine using new principles of low-intensity resonance therapy with the use of external storage media. As the shape of the body model of chicken egg is adopted in the cross-section proportions of Pythagoras.



CERTIFICATE & DECLARATION OF CONFORMITY FOR CE MARKING

Company-manufacturer contact details:

"Scientific-Methodic Center "Medinteh", LLC

Str. Borispilska, 9, building 3G, letter H,

Kiev, Ukraine, 02099

Tel/fax: +38(044)369-53-28 e-mail: medintech@list.ru

"Scientific-Methodic Center "Medinteh", LLC declares under their sole responsibility that their:

Machines for preparation of singlet-oxygen mixture
listed as the following models: Singlet TherapAir and WIT-S

comply with the Essential Requirements of the following EU Directives:

Machinery Directive 2006/42/EC

Low Voltage Directive 2006/95/EC

Electromagnetic Compatibility Directive 2004/108/EC

RoHS 2 Directive 2011/65/EU

and further conform with the following EU Harmonized Standards:

EN 60204-1:2006 + A1:2009

EN 61000-6-3:2007+A1:2011

EN 61000-6-1:2007

Dated: 20 February 2015

Position of signatory: Chief of "Scientific-Methodic Center "Medinteh", LLC

Name of Signatory: Mykola Chukchraiev

Signed below:

on behalf of "Scientific-Methodic Center "Medinteh", LLC

EU Authorised Representative: Singlet Oxygen Machines Limited (machine model - Singlet TherapAir)

Unit 1, Ashton Lodge Farm, Hartwell Road, Northamptonshire, NN7 2JT, United Kingdom

Company Director: Tatyana Millard Tel.: +447765244025

EU Authorised Representative: WIT GmbH (machine model - WIT-S)

Odertalweg 16, 76275 Ettlingen, Germany

Company Director: Eugen Lazarev Tel.: +4917681016737

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Authors:

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Radomska Szkoła Wyższa w Radomiu, Polska
ul. 1905 roku 26/28
26-600 Radom
tel: 048 383 66 05
E-mail: med@rsw.edu.pl <<mailto:med@rsw.edu.pl>>

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