Arteriovenous Difference in Blood Oxygen Saturation as a Diagnostic Index of Ozone Effect on the Organism

E.I. Nazarov

Scientific Production Enterprise “Econika”, All-Ukrainian Association of ozone therapists and manufacturers of equipment for ozone therapy - Odessa, Ukraine
www.ozonetherapy.com.ua\equipment_en.html, ozoninfo@farlep.net

Abstract

We suggest to use three simple test for study the influence of ozonetherapy to patient.**Test of average blood flow velocity**. In order to simplify the procedure of oxygen transport velocity estimation we have suggested the method of determination of blood flow velocity by oxygen transport velocity from the lungs to the point located on the patient’s extremity. Practically this procedure consists in measuring time interval between the patient’s inhalation of pure oxygen and moment of spasmodic growth of the arterial blood saturation in the tissue under the nail plate of the middle finger of the left hand. For measuring of the given characteristics the presence of pulsoximeter is needed. To simplify the procedure of the average blood flow velocity measuring we have developed a special measuring device “Bozon-test-1.This device allows to measure the average blood flow velocity by noninvasive method two-wave photopletizmography. The device has a liquid-crystal display, which represents photopletizmogram of the finger, diagram of the average blood flow velocity change during the the average blood flow velocity test and digital values of the pulse frequency and average velocity of blood movement. The use of the described technique allows to plan more rationally the duration of the ozone therapy in treatment of the diseases related to the cardiovascular system illnesses. **Test of vital saturation of venous blood by oxygen**. One of the indices of efficacy of oxygen utilization in the tissues is oxygen tension in the venous blood. We have studied the influence of ozone therapy on this parameter. A two-wave photometer in “Bozon-test-1”can be used for quantitative estimation of partial oxygen pressure in the venous blood.. The venous blood in the volume of 1 ml is placed in the segment of the PVH tube of 4 mm in a diameter and installed in a remote photosensor. The tube used for autogemotherapy major with ozone can be also tucked in a sensor that allows to measure the oxygen pressure in the venous blood dynamics in the process of blood taking. Two basic types of reaction of patients’ venous blood to ozone therapy are found out. The first consisted in the increase of partial oxygen pressure in the venous blood level, the second reaction consisted in the partial oxygen pressure in the venous blood level decline. In both cases partial oxygen pressure in the venous blood level tends to the norm of partial oxygen pressure (about 40 mm Hg) We consider that the reduced oxygen pressure in the venous blood level of the patients with the first type of reaction is brought about by the reduced peripheral blood flow. Test of vital saturation of venous blood by oxygen show that autogemotherapy major with ozone sharply increases the blood flow velocity. Comparison of the autogemotherapy major with ozone course effects on the blood flow velocity and oxygen pressure in the venous shows that it is more suitable to use the test of the blood flow velocity for patients of the first group of reaction as this test is characterized by dose-dependence. **Test of the resulted saturation of venous blood**. One of the most often mentioned phenomena of the ozone effects on an organism is reduction of hemoglobin affinity to oxygen which is caused by the ozone-induced increase of 2.3-diphosphoglycerate level in blood. The quantitative expression of this phenomenon is elevation of the partial pressure of oxygen, corresponding to the half saturated blood (P50). We suggest a simplified method of P50 monitoring We suggest to use the value of blood saturation SpO_2 at standard oxygen pressure in a gas mixture as a diagnostic parameter instead of searching for the P50 values. The apparatus necessary for such measurements consists of measuring device "Bozon-test-1" and a balloon with a standard gas mixture, containing 3.4 per cent of oxygen, 4.5 per cent of carbon dioxide and 92.1 per cent of nitrogen (oxygen partial pressure is 26 mm Hg

One of factors preventing development of ozone therapy is a weak propagation of methods of objective control of ozone physiological effects. At present a physician dealing with ozone therapy has only one instrument of diagnosis at his disposal specifically related to ozone therapy - biochemiluminometer [1]. The application of this device allows to estimate correctly the influence of ozone on the antioxidant system of a patient. At the same time, other major patient's systems of vital functions remain beyond accessibility in diagnostic facilities available to a practicing ozone therapist. Therefore, it generated a need of development of auxiliary apparatuses for estimation of ozone correction necessity of the organism vitally important system functioning at the stage of planning the course of ozone therapy and correction completeness at the stage of its conduction.

Preliminary results of the research directed at creation of diagnostic method of ozone therapy influence on the cardiovascular system (CVS) are presented in the work. The choice of this very direction of research is determined by the special sensitivity of the CVS to ozone. Indeed, there are at least four factors of the therapeutic influence of ozone on the CVS function: 1) reduction of hemoglobin affinity to oxygen;2) NO- induced vasodilatation; 3) improvement of microrheologic properties of the erythrocyte membrane, 4) hypocoagulation effect [2].

From the list of basic effects of ozone the following basic moments are chosen: a) one of major consequences of ozone effect on the CVS is improvement of the oxygen transport function of blood and, as a result, strengthening of oxygen metabolism; b) the improvement of oxygen transport function of blood is achieved by facilitation of blood delivery to the terminal areas of arterial network (factors 2-4, see higher) and facilitation of oxygen release from blood (factor 1). Thus, estimation of ozone influence on the CVS at the first approach can be conducted, measuring blood flow velocity and efficiency of oxygen utilization in the tissues. We have devised three simple methods of diagnosis of ozone influence on the CVS.

Test of average blood flow velocity.

At present the parameters of hemodynamics are easily controlled by the methods of ultrasonic dopplerography. However, this method is not always accessible for a number of reasons. Therefore, in order to simplify the procedure of oxygen transport velocity estimation we have suggested the method of determination of blood flow velocity by oxygen transport velocity from the lungs to the point located on the patient's extremity. Practically this procedure consists in measuring time interval between the patient's inhalation of pure oxygen and moment of spasmodic growth of the arterial blood saturation in the tissue under the nail plate of the middle finger of the left hand. It is necessary to decrease this interval by two seconds during which the blood moves from the lungs to the aorta root [3]. Further from the collected value and distance from the jugular incisure to the terminal phalanx of the middle finger of the left hand we calculate the average velocity of blood movement (AVDM).

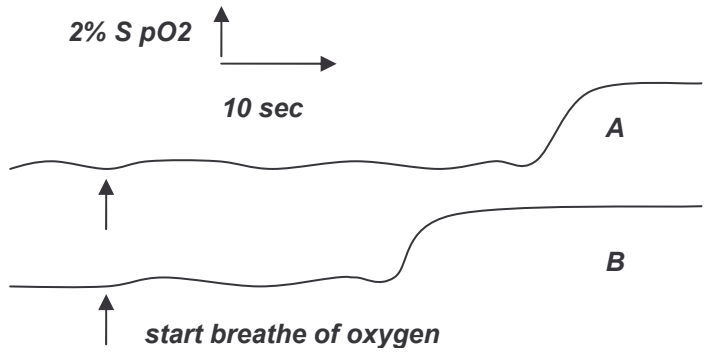

Fig.1. Record of the arterial blood saturation (ABS) change during the procedure of the AVDM measuring. Patient K. aged 56,arterial hypertension of II stage A – before treatment (mean time 34±1.2 sec), B - after the fourth procedure of major autohemotherapy (AGMO) (mean time 21±0.9 sec).

For measuring of the given characteristics the presence of pulsoximeter is needed. To simplify the procedure of the AVDM measuring we have developed a special measuring device "Bozon-test-1", one of functions of which is the ABS measuring. This device allows to measure the ABS by noninvasive method of intracutaneous two-wave photopletizmography. The device is a remote sensor to the ozone therapeutic complex "Bozon", but it can be used regardless of it. The

device has a liquid-crystal display, which represents photopletizmogram of the finger, diagram of the ABS change during the AVDM test and digital values of the pulse frequency and AVDM.

Fig. 1 presents the original records change of the ABS registration during the procedure of the AVDM determination before and after of the course of ozone therapy. Fig.2 represents the dynamics of the AVDM increase of the same patient K. during the course of ozone therapy. While using this method we studied the change of the blood flow velocity during the course of the AGMO procedures (Fig. 2).

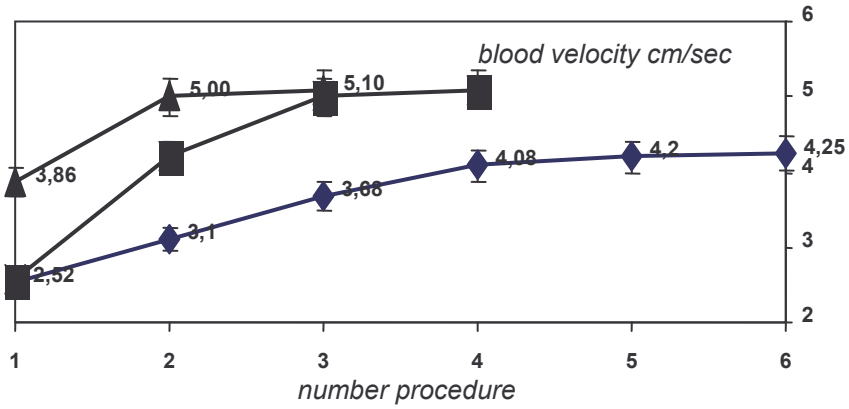

Fig.2. ♦-patient K.. ■-patient P. ▲-patient L. All patients were given the AGMO procedures (100 ml of blood, dose- 2 mg of ozone, procedures in a day).

As it is seen from the picture, the blood flow velocity evenly increases during the first four procedures. Thus, the AVDM increases by 68%. Real acceleration of the blood movement through capillaries is probably even higher. Actually, it is known that time of the blood movement from the lung to the aorta root makes about 2 sec, and the rate of the blood movement in the large arteries makes about 7.5 cm/sec. We will consider that general length from the artery root to the area between the elbow, after which the narrowing of the humeral artery begins, makes 70 per cent of the general length to the nail plate of the middle finger. A simple calculation shows that time of the blood movement from the lung to the arteries of the large caliber makes about 10 seconds only. As the rate of movement via the large arteries is probably little subject to the ozone influence, shortening of the interval by 11 sec. (see Fig.1) refers to the area between the elbow joint and end of the first phalanx of the middle finger. A simple calculation shows that the velocity made about 1 cm/s in this area at the beginning and grew to 2.4 cm/s at the end of treatment, i.e. grew more than twice.

It is seen from Fig.2 that the dynamics of the AVDM elevation for different patients varies. Obviously that two procedures are enough for the patient L., the patient P. needs three, and the patient K. requires 4-5 procedures. Thus, the use of the described technique allows to plan more rationally the duration of the ozone therapy in treatment of the diseases related to the CVS illnesses. We also think that this test can be used for estimation the efficacy of ozone therapy for all diseases, pathogenesis of which is related to oxygen insufficiency.

Test of vital saturation of venous blood by oxygen.

One of the indices of efficacy of oxygen utilization in the tissues is oxygen tension in the venous blood. We have studied the influence of ozone therapy on this parameter. A two-wave photometer in “Bozon-test-1”can be used for quantitative estimation of partial oxygen pressure in the venous blood (POPV). POPV is registered by the method of two-wave spectrophotometry. The venous blood in the volume of 1 ml is placed in the segment of the PVH tube of 4 mm in a diameter and installed in a remote photosensor. The tube used for AGMO with ozone can be also tucked in a sensor that allows to measure the POPV dynamics in the process of blood taking.

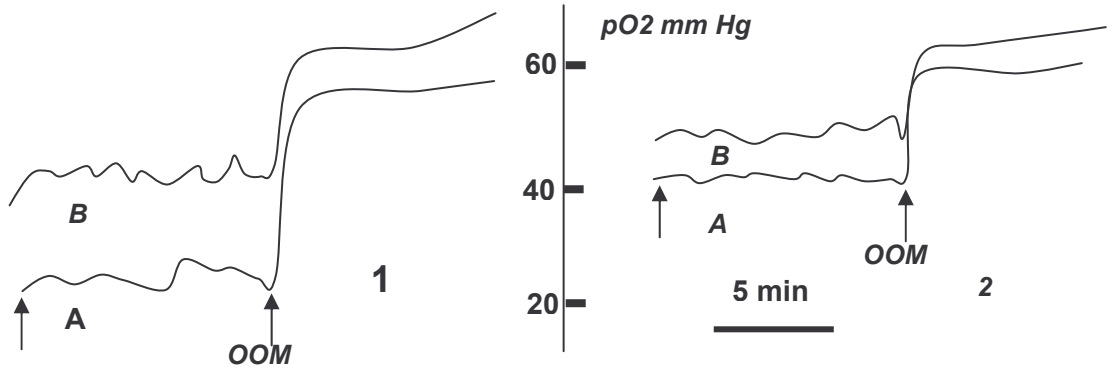

Fig.3. Two types of the POPV changes under the AGMO action. A – before the course, B - after the course of 4 AGMO procedures (2mg, 100 ml of blood), pointers indicate the moments of beginning of blood taking and returning after ozonization .

The device has a liquid-crystal display which presents the digital value of POPV and diagram of the POPV change during the procedure of major autohemotherapy. Application of the graphic record is quite necessary because POPV varies extraordinarily greatly during the blood taking that is related to the reflex reaction of vascular tonicity to the changing emotional state of the patient. The device software gives the average POPV estimation during the procedure, but a doctor can make corrections in this value, proceeding from the curve character. We have studied the dynamics of the POPV change during the AGMO procedure in 8 patients. All patients got the AGMO procedure with a dose of 2 mg per 100 ml of blood. The typical record of POPV during the AGMO procedure is shown in Fig.3. Two basic types of reaction of patients' venous blood to ozone therapy are found out. The first reaction (six patients) consisted in the increase of the POPV level, the second reaction (two patients) consisted in the POPV decline. In both cases POPV tends to the norm of partial oxygen pressure (about 40 mm Hg)

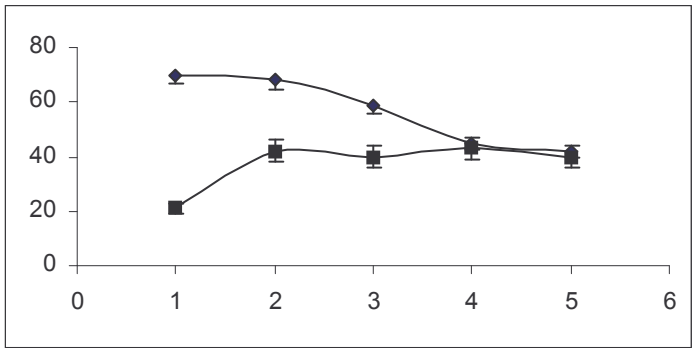

Fig.4. Two types of the POPV reaction to the AGMO course ♦patient B., 1965, invalid of III group, peroneal amyotrophy Charkot-Marie, ■ – patient P., 1942, high blood pressure III stage. (5 procedures, 100 ml of blood, 2 mg of ozone – a dose for the procedure). Ordinate axis- POPV in mm Hg, Abscissa axis- number of the procedure.

The example of the reaction of the second type is shown in Fig.1 Before treatment the patient with a diagnosis of inherited peroneal amyotrophy Charkot-Marie marked the episodic refusals in adduction of leg muscles, accompanied by falling down, pain and parenthesis in the legs, and also distal hyposthesia. It is seen in the picture that this disease is characterized by the sharp exceeding of POPV and, accordingly, reduction of the arteriovenous difference. As the picture shows, the course of five procedures of major autohemotherapy caused normalization of the VPDK venous level. The POPV normalization was accompanied by reduction and disappearance of pains in the legs, improvement of gait. The episodes of ataxia during the course of ozone therapy were not repeated. The reaction of the second type was also found out in the elderly (1924), capable of working patient. After the AGMO course the patient marks sharp improvement of endurance to the physical loadings, improvement of the life quality. Similar self-accounts are collected from all patients of the first group. We consider that the reduced POPV

level of the patients with the first type of reaction is brought about by the reduced peripheral blood flow. It is evident from Fig.1 that AGMO sharply increases the blood flow velocity. Comparison of the AGMO course effects on the blood flow velocity and POPV shows that it is more suitable to use the test of the blood flow velocity for patients of the first group of reaction as this test is characterized by dose-dependence. For the patients of the second group of reaction the test to POPV is probably more preferable.

Test of the resulted saturation of venous blood.

One of the most often mentioned phenomena of the ozone effects on an organism is reduction of hemoglobin affinity to oxygen which is caused by the ozone-induced increase of 2.3-diphosphoglycerate level in blood.

The quantitative expression of this phenomenon is elevation of the partial pressure of oxygen, corresponding to the half saturated blood (P50). Realization of this method requires difficult enough gas equipment, practically inaccessible to the ordinary physician-ozone therapist. We suggest a simplified method of P50 monitoring The essence of the method is illustrated by the diagrams of dependence of blood satiation on oxygen pressure: 2 – the norm (P50 - 27 mm Hg), 1 – blood alkalosis, 3 - blood acidosis or increased level of 2,3-diphosphoglycerate in red corpuscles (ozone therapy).We suggest to use the value of blood saturation SpO_2 at standard oxygen pressure in a gas mixture as a diagnostic parameter instead of searching for the P50 values. Such an approach reduces complex monitoring of blood affinity to oxygen dozens of time. We name the required saturation values S1 and S2 the resulted saturations (RS).

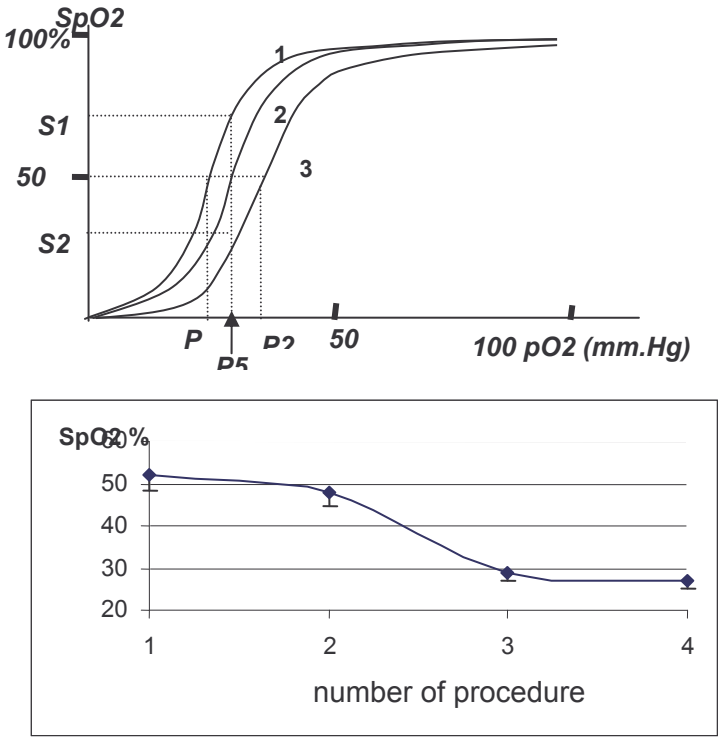

Fig.5 Change of the resulted blood saturation during the OSS course (1mg/l, 200 ml). Patient E., 1962, a diagnosis is a chronic pyelonephritis.

We get the PN value by determination of saturation degree of blood hemoglobin with oxygen in lancing by a gas mixture, containing oxygen and carbon dioxide in the ratio corresponding to half saturation of blood in the norm. The apparatus necessary for such measurements consists of measuring device of partial VPDK ("Bozon-test-1") and a balloon with a standard gas mixture, containing 3.4 per cent of oxygen, 4.5 per cent of carbon dioxide and 92.1 per cent of nitrogen (oxygen partial pressure is 26 mm Hg).Treatment of blood with moistened gas is made in a thermostatic chamber. The RS test is a very sensitive index of the ozone therapy influence on properties of the blood Fig.5. The patient P. got only 0.8 mg of ozone during the

course, however, the RS test confidently reflected quantitative descriptions of ozone effect on affinity of blood hemoglobin to oxygen.

The studies conducted in the report are surely of a preliminary character and require further development and deepening. We hope that the application of complex “Bozon-test-1” will allow to devise practical recommendations on the rational planning of treatment course of patients with a different type and severity of the disease.

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