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Research Article

The Effectiveness of Intravenous Infusion Ozone Therapy in Patients with Fatty Hepatosis

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Abstract

Fatty hepatosis or non-alcoholic fatty liver disease is a condition in which more than 5% of hepatocytes accumulate fat, which occurs in the absence of excessive alcohol consumption. There are several types of the disease: 1) simple steatosis is a benign condition in which there is no inflammation, there is no progression of the pathological process in the liver, but cardiovascular diseases and their complications can progress; 2) non-alcoholic steatohepatitis, which, in addition to steatosis, is characterized by lobular inflammation, balloon degeneration and fibrosis of hepatocytes with the risk of progression to liver cirrhosis and the development of hepatocellular cancer [1]. The antioxidant function of the liver suffers significantly in such diseases due to functional and organic lesions of its parenchyma with the accumulation of lipid peroxidation products. Therapeutic correction of pathological products of altered metabolism is possible with the use of medical ozone. The entry of singlet oxygen molecules into the systemic circulation has an antioxidant, anti-inflammatory and detoxifying effect.

Keywords: *Intravenous Infusion Ozone Therapy; Fatty Hepatosis; Hepatocellular Cancer*

Introduction

Fatty hepatosis or non-alcoholic fatty liver disease is a condition in which more than 5% of hepatocytes accumulate fat, which occurs in the absence of excessive alcohol consumption.

Methods

Course empirical (from 5 to 7 sessions) ozone therapy was performed in 54 patients (34 men and 20 women) aged 26 to 72 years with an established diagnosis of hepatosis (in 19 cases toxic and in 35-non-alcoholic). The diagnosis was justified by clinical signs of liver damage, ultrasound diagnostic data and biochemical parameters. During treatment, hepatoprotectors, metabolic correctors and antioxidant drugs were not prescribed. Intravenous infusions of an ozone-oxygen mixture bubbled in saline solution (250 ml) using the Medosons-BM device (Russia, Nizhny Novgorod) were carried out 2 to 3 times a week at a rate of 50 drops per 1 minute. A step-by-step increase in the ozone concentration from 800 to 1500 micrograms/l was carried out under the supervision of a specialist doctor, depending on the individual reaction of the patient. Before the start, during each session and after the course of treatment, the available hemodynamic and clinical and laboratory parameters were determined.

Erythrocyte deformability was assessed by osmotic gradient ektacytometry in wide osmolality range of suspension medium in a Couette shearing cell [2]. An osmoscan was used to measure blood osmolality O (EImax), at which the deformability of erythrocytes EImax, measured at 10 N/m^2, reached maximum value; osmolality Omin upon full isotropic swelling of erythrocytes as an extent of osmotic fragility of erythrocytes; the degree of hemoglobin hydration, or the internal viscosity of the cell Ohyper and deformability EImin at osmolality of isotropic erythrocyte swelling (Omin) as an extent of erythrocyte membrane permeability for water [3]. The assessment of a reversible erythrocyte aggregation was performed by a piezodynamic method based on recording light scattering curves of 5 mm3 of whole blood in a glass cuvette 25 µm in height [4]. The starting motion time of erythrocytes aggregates, or minimal stability of the aggregates Tmin, time of full disaggregation of erythrocytes, or maximal stability of the aggregates Tfull and rate of spontaneous aggregation 1/Tagg, where Tagg is a half-cycle of aggregation, or time in which the amplitude of a photometrical signal decreased 2-fold as compared to the maximum, were measured.

Digital of the experimental results are presented as the arithmetic mean and its standard mean square error. The significance of differences was estimated using Student's t test.

Results

All patients underwent the procedures, there was an improvement in well-being, the disappearance of dominant complaints, the appearance of cheerfulness and optimism. There were no significant fluctuations in the dynamics of blood pressure values, heart rate and parameters of the general blood test. There was a decrease in the concentration of total bilirubin in the blood from (26.5 ± 0.5) mmol/l to (21.5 ± 0.4) mmol/l, $p < 0.05$ and transaminase indices: ALT from (51.7 ± 2.8) mmol/l to (37.8 ± 2.4) mmol/L, $p < 0.02$) and AST from (38.7 ± 1.9) mmol/l to (31.5 ± 1.8) mmol/l, $p < 0.05$).

Deformability EImax and water permeability of erythrocyte membranes EImin increase after each session of ozone therapy. Such effect has a stable tendency during the whole observation period. Significant changes in erythrocytes shape Omin were not revealed after the sessions, but a tendency towards an increased toroidality of erythrocytes or enhanced hydrodynamic shape of the cells is very stable. The parameter Omin is (150 ± 3) mOsm at the beginning of the experiment, and it is (139 ± 2) mOsm by the end of the experiment ($p < 0.01$). By the end of the observation, maximal deformability is manifested already at (243 ± 2) mOsm, while it is revealed at (263 ± 3) mOsm at the beginning of the procedure ($p < 0.01$). The extent of hemoglobin hydration designated as Ohyper parameter was stable during the whole time period of observation.

During the course of treatment, the values of aggregation indicators decreased after each session and stabilize at a lower level compared to the initial values up to two months of follow-up after the completion of the procedures. For example, Tmin values before and 2 months after the treatment are (40 ± 4) sec and (24 ± 3) sec, respectively, which is a significant difference ($p < 0.01$). The Tfull values are (135 ± 9) sec and (118 ± 8) sec ($p < 0.05$), respectively. Moreover, the rate of erythrocytes aggregation 1/Tagg tends to increase during the observation of the patients despite a decrease after each session. Thus, ozone therapy course induces a prolonged decrease in rigidity characteristics of erythrocytes aggregates.

Discussion

An important role in forming blood rheological parameters and maintaining circulatory homeostasis belongs primarily to erythrocytes, since they are the most representative fraction of blood cells. Variability of deformational and aggregation properties of erythrocytes in different regions of the vascular bed is a component of nonspecific antihypoxic reaction in organization of an adequate blood flow in tissues and the efficiency of microcirculation [5]. Changes in erythrocyte rheological properties were traced in dynamics after treatment with intravenous injection of ozonized physiological saline with patients having complicated pathology. The experiments have shown that a decrease in minimal stability of the aggregates is observed after each session. Dynamic aggregation parameters 1/Tagg and Iagg returned to the initial values by next sessions. These changes could be explained by a decrease in blood viscosity after injection of 200 mL of physiological saline into the blood f low. However, long-term consequences of performed sessions suggested prolonged action of exactly ozonized injections, since the pattern of repeated changes observed after injections of nonozonized physiological saline had no long-standing effects. Erythrocyte aggregation parameters determined before each subsequent session corresponded to the initial values.

Deformation properties of erythrocytes are formed by elastic characteristics of cell membrane, its shape, and the viscosity of the internal content. The integral parameter of erythrocyte deformability Ie significantly increases in the experiments after injections and retains this tendency during the entire observation period. The reason for the enhanced deformability is the observed improvement of cells shape, which is reflected in the Omin parameter against the background of constant internal viscosity. Reduction in the toxicity of the medium in model conditions for maximum exhibition of erythrocyte deformability, which is reflected in the Oisot parameter, is also explained by these changes.

In general, it may be stated that ozone therapy positively affects erythrocyte deformation characteristics, reduces rigidity characteristics of erythrocyte aggregates without harmful consequences on the dynamics of spontaneous aggregation. The absence of damage from the performed procedure confirmed rigorous physicochemical estimation of the consequences of this procedure performed by Travagli., *et al*. [6], where all blood was treated with ozone at concentrations lower than 80 μg/mL. The authors come to the conclusion that toxic ozone action in physiological concentrations is corrected by antioxidant plasma system in human blood. The dynamics of changes in assessed parameters shows an improvement in rheological properties of erythrocytes in patients with complex pathology not only during the treatment, but also in renewed blood 2 weeks, 1 month, and 2 months after the course of ozone therapy.

Conclusion

Thus, the use of ozone-oxygen mixture infusions in saline solution as a therapeutic effect in patients with fatty hepatosis is accompanied by a good clinical effect and an improvement in the strength characteristics of aggregates and rheological properties of erythrocytes.

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