Effects of Microwave Resonance Therapy on Erythrocyte and Plasma Proteins and Lipids in Alcoholics

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The content of lipid peroxides and protein carbonyls in erythrocytes and plasma were elevated in patients with alcoholism during abstinence. A course of microwave resonance therapy reduced the level of lipid peroxide in erythrocytes, but not in the plasma, and significantly decreased the content of protein carbonyls in the plasma and erythrocytes.

Key Words: *microwave resonance therapy; oxidative modification of lipids and proteins; alcoholism*

Microwave resonance therapy (MRT) is used for the treatment of many diseases [8], including the alcohol abstinence syndrome [3]. Various molecular mechanisms of the effects of the millimeter band electromagnetic radiation (EMR) on biological objects [1,6] were hypothesized, but these mechanisms and the ways of obtaining favorable therapeutic effect of MRT remain not quite clear.

Alcoholism is associated with the development of oxidative stress in the organism and oxidative modification of proteins (protein carbonylation) and lipids (LPO) [2]. The treatment leads to improvement of clinical characteristics and metabolic values, as well as to alleviation of oxidative stress. *In vitro* exposure of blood samples to millimeter band waves (microwaves) increases osmotic resistance of erythrocytes, reduces LPO intensity [6], and improves blood rheology and erythrocyte deformability [10]. Flow cytometry showed that microwave exposure of erythrocytes led to redistribution of phosphatidylserine in their membranes, which attests to their serious restructuring [11]. Blood exposure to EMR led to shifts in electrophoretic mobility of erythrocytes [7]. This fact gives grounds to suggest that microwave exposure leads to physicochemical changes in erythrocyte membrane as a result of redistribution of charged groups. Positive effect of MRT on plasma parameters reflecting the oxidative status was detected in patients unstable angina [9] and alcoholism [4]. These data indicate that EMR can arrest oxidative stress associated with pathological processes. No regular studies of MRT effects on the parameters reflecting oxidative modification of proteins and lipids in patients with alcoholism were carried out.

We studied the effect of MRT on LPO and protein carbonylation in the plasma and erythrocytes of patients with alcoholism during abstinence.

MATERIALS AND METHODS

The study was carried out on the plasma and washed erythrocytes of 46 male patients suffering from stage II alcoholism. In 30 of them traditional detoxification therapy was supplemented with 7 MRT procedures (main group). The rest 16 patients received standart detoxification therapy without MRT for 7 days (reference group). Control group consisted of 15 age-matched healthy individuals using no alcohol for at least 10 days before the study.

The studies were carried out in the patients twice: on admission to hospital in a state of abstinence (before therapy) and after therapy. Microwaves were generated by Stella-2 device (Spinor Firm), nonthermal intensity EMR of <3 mW/cm^2 power at 59-61 GHz frequencies, which corresponded to 5.1-4.7 mm. The exposure was

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TABLE 1. Content of TBA-RP and Protein Carbonyls in the Plasma and Erythrocytes of Donors of the Studied Groups (*M*±*m*)

Parameter	Object of study	Normal subjects	Patients before therapy	Patients after MRT	Patients after standart therapy
TBA-RP, nmol/ml	Plasma	2.653±0.252	5.412±0.235*	4.902±0.247*+	4.944±0.353*+
	Erythrocytes	3.624±0.038	3.969±0.106*	3.623±0.152+	3.996±0.163*
Protein carbonyls	Plasma, nmol/mg	0.315±0.019	0.572±0.017*	0.483±0.023*+	0.589±0.050*
	Erythrocytes, nmol/mg Hb	2.732±0.073	3.521±0.203*	2.660±0.211+	3.888±0.324*

Note. $p<0.05$ compared to: *donors, +patients before therapy.

carried out in the scanning mode (repeated cycles of frequency increase at a rate of 40 MHz/sec). The exposure was realized via a dielectric waveguide (contact area 0.64 mm^2) on the AT55 auricular bioactive point, 30 min every 24 h.

Lipid peroxides were measured spectrophotometrically by the reaction with thiobarbituric acid (TBA-RP), protein carbonyls by the reaction with 2,4-dinitrophenylhydrasine.

The results were statistically processed using the Mann—Whitney *U* test, Student *t*, and Wilcoxon test for independent and related samples. The differences between the groups were considered significant at $p<0.05$. The normality of distribution was verified using the Kolmogorov—Smirnov test.

RESULTS

Before therapy the content of lipid peroxides and protein carbonyls in the plasma and erythrocytes of alcoholics during abstinence was higher than in the control. This indicates the development of oxidative stress in this cohort of patients.

After therapy, plasma level of TBA-RP decreased significantly in the main and reference groups, but remained above the control (Table 1). Hence, standard therapy led to the same reduction of plasma LPO products as therapy including MRT. The content of TBA-RP in erythrocytes returned to normal only in patients of the main group receiving MRT. In the reference group, the erythrocyte content of TBA-RP virtually did not change after therapy (Table 1). Hence, MRT led to changes in lipid peroxide levels in erythrocytes, but not in the plasma.

The concentration of protein carbonyls decreased significantly after MRT in erythrocytes and plasma (Table 1). In erythrocytes, the level of protein carbonyls decreased to the control level, while in the plasma this value still surpassed the control level. In the reference group, this parameter in the plasma and erythrocytes did not change after therapy. Hence, MRT promotes reduction of protein carbonyl levels in the plasma and erythrocytes.

These results demonstrate that MRT reduces the content of proteins and lipids modified as a result of oxidative stress (under conditions when high rate of free radical formation and/or reduced capacity of the antioxidant system of a cell lead to an increase in the common levels of radical compounds).

An important result of this study is demonstration of a stronger effect of MRT on erythrocyte proteins and lipids in comparison with plasma proteins and lipids. This once more confirms the important role of the biological membrane in perception of the millimeter band EMR in MRT.

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