Effect of Oxygen Aeroions on Platelet Aggregation and Lipid Peroxidation in Health and Peritonitis

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In patients with peritonitis, the biological effects of oxygen aeroions reflect the interplay between molecular and cellular effects manifesting themselves in the inhibition of lipid peroxidation, increased antioxidizing potential of blood plasma, and decreased aggregating activity of platelets.

Key Words: *platelet aggregation; lipid peroxidation; malonic dialdehyde, peritonitis; oxygen aeroions*

Platelets are the major component of hemostasis regulation, providing informational exchange at the molecular and cellular levels [1]. Plasma lipids are a variable chemical component that modulates functional activity of platelets; the state of plasma lipids strongly depends on the intensity of peroxidative processes [2,6]. However, intensification of lipid peroxidation (LPO) is a pathogenic factor provoking molecular and cellular interactions which underlie homeostatic perturbations. Therefore, the timely correction of LPO disturbances is an urgent problem.

For the investigation of impaired exchange of information in the blood we have chosen peritonitis, since the thrombohemorrhagic syndrome and LPO play a key role in its pathogenesis [3,4]. In the present study we examined the effect of oxygen aeroions on platelet aggregation and plasma lipids in health and peritonitis.

MATERIALS AND METHODS

Experiments were performed on 24 adult mongrel dogs. Peritonitis was modeled under sodium thiopental anesthesia (0.04 g/kg body weight) by intraperitoneal injection of 20% fecal suspension (0.5 ml/kg body weight). The abdominal cavity was sanitated after 24 h. Aeroionotherapy was applied at the early postoperative period using the Chizhevskii luster for 1.5 h at an intensify of 5×10^5 aeroions/cm^3 air (20 biounits by Chizhevskii) [5].

Venous blood was stabilized with 3.8% sodium citrate (9:1, v/v). Platelet-rich plasma was prepared by blood centrifugation at 200*g* for 10 min. Platelet concentration in a sample was adjusted to 2×10^5 cells/μl. ADP (final concentration 20 μM) was used as a

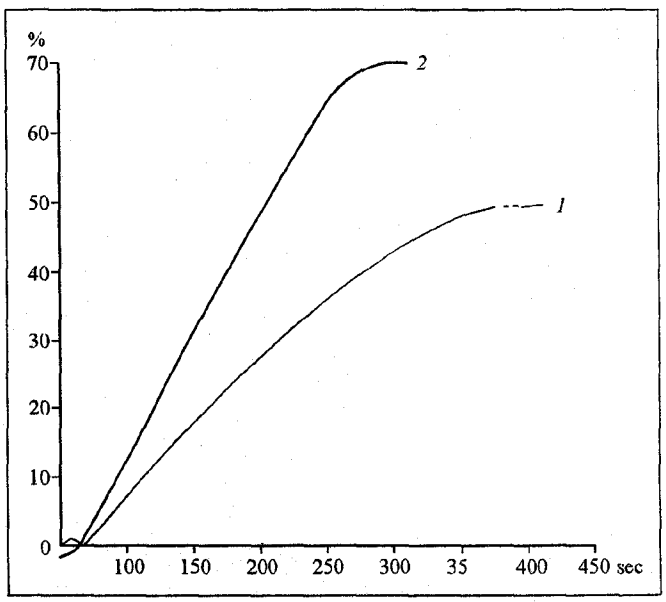

Fig. 1. Light absorbance of platelet-rich plasma after the addition of 20 μM ADP in health (*1*) and peritonitis (*2*).

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platelet activator. The kinetics of platelet aggregation was recorded in a Thromlite-1006 two-beam aggregometer (BioKhimMak, Moscow). The following parameters were determined: the maximum relative change in light absorbance as the degree of aggregation, the tangent of the slope angle as the rate of aggregation, and time and character of aggregation.

The intensity of LPO in plasma was measured using the thiobarbituric test. Antioxidizing activity of lipids and plasma was assayed using 5 μM iron (II) sulfate as a prooxidant.

RESULTS

In healthy animals, the degree and rate of platelet aggregation decreased, while the time of aggregating increased throughout the entire period of aeroionization starting from the first session (Table 1). These effects reflect the activity of aeroions at the cellular level and their ability to modulate cell relationships and metabolic processes.

In experimental peritonitis, platelet aggregation activity increased considerably (Fig. 1); it decreased as a result of complex therapy with oxygen aeroions. After several sessions of aeroionotherapy, the parameters characterizing ADP-induced platelet aggregation were practically the same as in the control and further decreased by the 5th-7th session (Table 2).

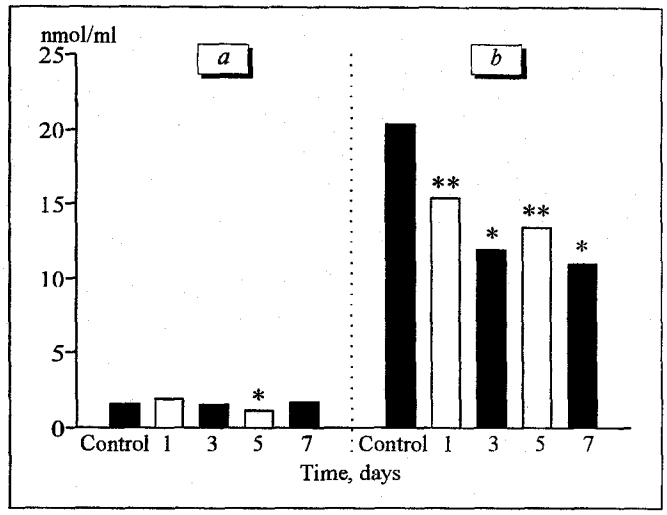

Fig. 2. Plasma MDA content before (*1*) and after (*2*) addition of prooxidant as a function of the number of aeroionotherapy sessions. Here and in Fig. 3: *$p<0.001$, **$p<0.01$ compared with the control.

In healthy animals, oxygen aeroions suppressed the formation of malonic dialdehyde (MDA) and markedly increased antioxidant activity of plasma lipids (Fig. 2). Presumably, the biological effect of negatively charged oxygen ions involves modification of free-radical oxidation of lipids, and this adequate mechanism of biostimulation can be employed to control peroxidation under pathological conditions.

TABLE 1. Effects of Oxygen Aeroions on Platelet Aggregation in Healthy Dogs (*M±m*)

Observation period	Degree of aggregation	Aggregation rate	Aggregation time
Initial value	39.29±1.94	1.32±0.10	182.9±7.57
Number of sessions:			
1	26.29±3.27**	0.62±0.06*	223.6±11.9*
3	32.50±3.00	0.88±0.09**	232.3±17.7***
5	20.00±1.84*	0.46±0.08*	223.0±6.3*
10	28.27±2.27**	0.61±0.08*	228.0±14.2***

Note. *$p<0.001$, **$p<0.01$, ***$p<0.05$ compared with the initial value.

TABLE 2. Effects of Oxygen Aeroions on Platelet Aggregation in Peritonitis (*M±m*)

Observation period	Degree of aggregation	Aggregation rate	Aggregation time
Initial value	33.30±4.76	1.21±0.15	123.6±17.8
Peritonitis	55.30±5.19	2.28±0.34	110.5±16.8
After surgery:			
1 day	51.00±2.90	1.80±0.09	122.3±17.2
with aeroions	33.30±3.04	1.22±0.06	187.9±13.0
3 days	45.90±5.31	1.47±0.27	110.9±17.5
with aeroions	30.40±3.10	0.99±0.09	201.5±11.6
5 days	33.00±1.95	1.22±0.15	107.5±12.9
with aeroions	26.90±1.93	0.81±0.08	212.8±11.7

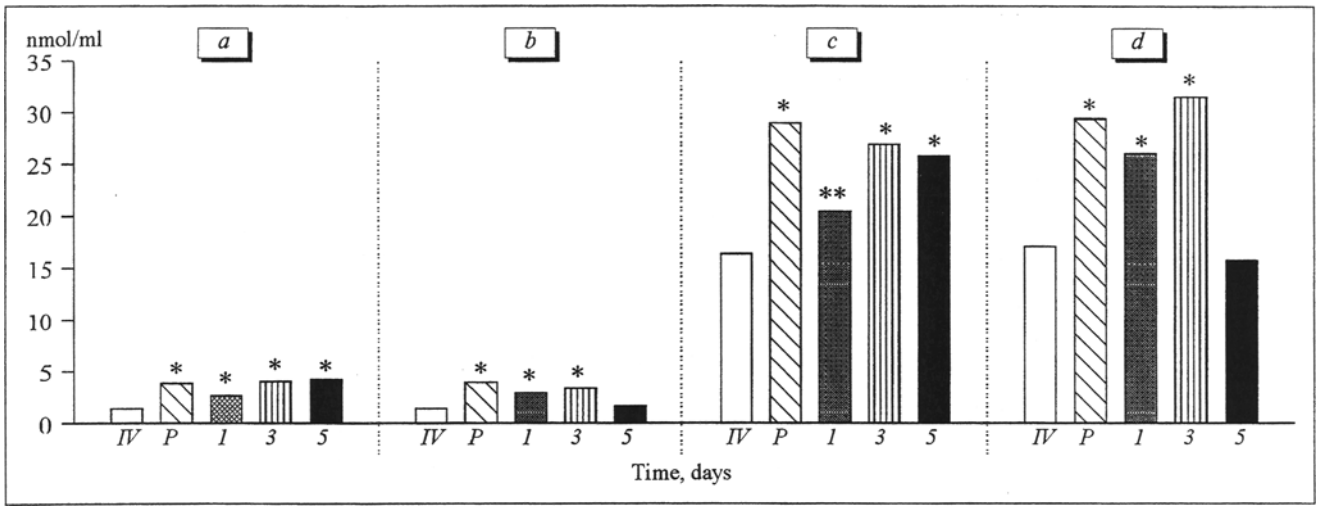

Fig. 3. Plasma MDA content in peritonitis (*a*), during aeroionotherapy (*b*), upon stimulation with Fe (II) without (*c*) and with aeroionotherapy (*d*) as a function of the number of sessions. *IV*) initial value; *P*) peritonitis.

Inflammatory reactions in peritonitis were accompanied by intensification of LPO and reduction in antioxidant activity of blood plasma (Fig. 3). After surgery, blood MDA content in dogs with peritonitis was much higher compared with in the control. Conservative therapy led to a strong tendency toward a gradual increase in the antioxidant activity of plasma lipids.

The complex therapy of peritonitis with the use of oxygen aeroions lowered the intensify of LPO (Fig. 3) and accelerated recovery of the dogs. The tendency toward a decrease in blood MDA content was observed after 1-3 sessions of aeroionotherapy. At the same time, the antioxidative activity of plasma lipid increased.

Thus, LPO inhibition and stimulation of antioxidant activity of plasma lipids are the components of biological effect of aeroions. Presumably, the fast recovery of the animals is associated with LPO reduction. Inhibition of free-radical oxidation of lipids in the blood leads to a decrease in platelet aggregation activity and, consequently, to suppression of the thrombohemorrhagic syndrome. Our results indicate that oxygen aeroions can be recommended for the treatment of peritonitis.

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