EXPERIMENTAL EFFECT OF SOME HORMONES ON THE INTENSITY OF THE FREE-RADICAL LIPID OXIDATION REACTION

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The effect of adrenalin and hydrocortisone on free-radical oxidation of lipids in erythrocytes was investigated in experiments on rabbits *in vivo* with modified lipid metabolism. Adrenalin in a dose of 0.1 mg/kg and hydrocortisone in a dose of 5 mg/kg were found to cause an increase in the concentration of hydroperoxides of fatty acids. The results confirm the view that adrenalin and hydrocortisone, in experiments *in vivo*, have antioxidative properties which are evidently indirect in character, associated with their lipid-mobilizing effect.

KEY WORDS: *adrenalin; free-radical oxidation; hydrocortisone; erythrocytes.*

Catecholamines and steroids, on the one hand, are known to inhibit the reactions of free-radical oxidation of lipids *in vitro*, for example, in rat liver mitochondria, and on the other hand, if administered *in vivo*, to have a lipid-mobilizing effect, when there is a real possibility for activation of free-radical oxidation of lipids in biological membranes.

The object of the present investigation was to study the effect of certain catecholamines (adrenalin) and steroids (hydrocortisone) on free-radical lipid oxidation reaction in experiments *in vivo*

EXPERIMENTAL METHOD

Experiments were carried out on 15 chinchilla rabbits weighing 3-4 kg. A disturbance of lipid metabolism was produced by Panin's method [8, 9] by intravenous injection of 50 mg dithizone. Seven days after injection of the dithizone and the development of diabetes the rabbits were given daily intramuscular injections of hydrocortisone (5 mg/kg) and adrenalin (0.1 mg/kg) for seven days. The concentration of hydroperoxides was determined [5] on the 1st, 7th, and 14th days of the experiment. The resistance of the erythrocytes [6] and the concentration of total lipids [11], cholesterol [15], and free fatty acids (FFA) [14] also were determined.

EXPERIMENTAL RESULTS

In the course of manifestation of the lipid-mobilizing effect due to injection of adrenalin and hydrocortisone it was possible to distinguish clearly an increase in the initial level of hydroperoxide of fatty acids in the erythrocytes, reflected in a change in their optical density at 233 nm. The increase in the initial level of hydroperoxides of fatty acids, i.e., the increase in the level of oxidation of lipids, was so substantial that the addition of initiators of the free-radical lipid oxidation reaction led to a decrease rather than an increase in the concentration of hydroperoxides.

Correlation between the initial hydroperoxide level, the MHb level, catalase index, and resistance of the erythrocytes is illustrated in Fig. 1. Dynamics of changes in the total lipid, FFA and cholesterol levels of the rabbits is shown in Table 1. The results demonstrate correlation between the blood lipid concentration raised by injection of adrenalin and hydrocortisone in animals with dithizone diabetes, the lipid hydroperoxide level of the eryth-

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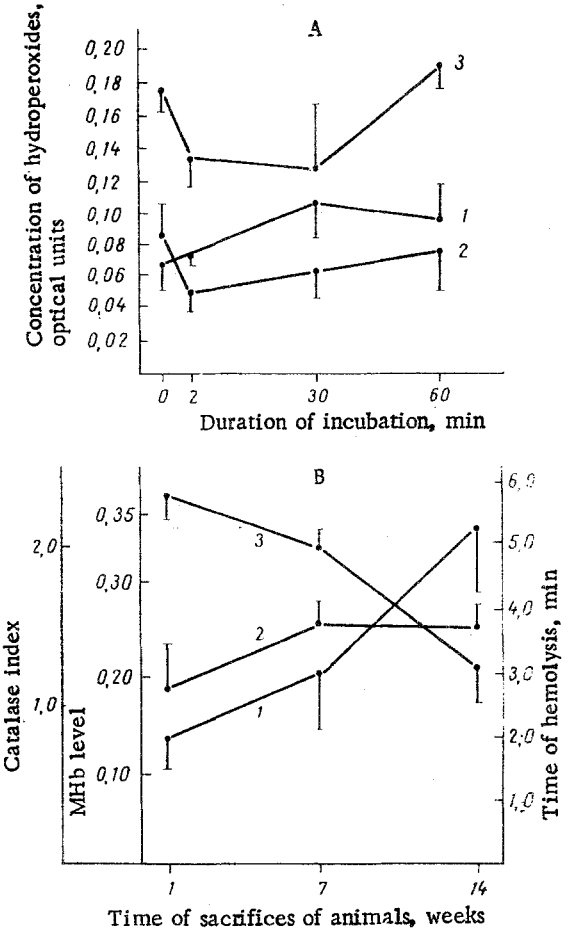

Fig. 1. Changes in levels of hydroperoxides, MHb, (methemoglobin) catalase index, and resistance of erythrocytes under the influence of adrenalin and hydrocortisone. A) Level of hydroperoxides: 1) initial data; 2) 7th day of experiment; 3) 14th day of experiment. B) MHb level (1), catalase index (2), and resistance of erythrocytes (3).

TABLE 1. Effect of Adrenalin and Hydrocortisone on Indices of Lipid Metabolism in Blood Plasma of Rabbits with Dithizone Diabetes (M ± m)

	Number of investigation	Total lipids, mg%	Total cholesterol, mg%	FFA, μg-eq/liter
Control	15	118,3±20,1	41,7±4,8	131,6±10,1
Experiment				
7th day	12	325,0±29,7*	115,9±8,9*	396,8±35,1*
14th day	4	345,0±8,6*	141,2±21,2*	212,0±39,3*

*P < 0.05.

rocytes, their resistance, the catalase index, and the MHb concentration in the erythrocytes. The pro-oxidative properties of adrenalin and hydrocortisone, manifested *in vivo*, could be due to a variety of facts. First, there is evidence that administration of adrenalin to an animal sharply accelerates lipolytic processes and causes an increase in the blood level of lipids, mainly unsaturated fatty acids [7, 11], the basic substrate for reactions of free-radical lipid oxidation in biological membranes [16]. Second, a sharp increase in the blood lipid concentration creates conditions for disparity between the rate of enzymic

and free-radical oxidation of lipids in favor of the latter [4]. Third, catecholamines (adrenalin) for example, may themselves, be oxidized in various ways [13]. Substances formed in the process of oxidation, like the end-products of oxidation, can behave as regulators of lipid peroxidation reaction [10]. It is now well known [2], for instance, that during oxidation of adrenalin into adrenochrome an oxygen anion-radical is formed and undergoes dismutation successively by the enzymes superoxide dismutase and catalase. In the process of this dismutation a hydroxyl radical may appear and activate the free-radical lipid oxidation reactions.

Whereas in reactions *in vitro* hormones and, in particular, adrenalin thus posses antioxidative properties (on account of the presence of a free phenol group in their structure [12], in experiments *in vivo* they can possess pro-oxidative properties. Relations between the direct antioxidative properties of hormones and their indirect pro-oxidative properties evidently ultimately determine the biological effectiveness of hormones in general and their influence on free-radical lipid oxidation reactions in biological membranes and also the physicochemical properties of these membranes in particular.

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