ALLERGOLOGY

Correction of Lipid Composition of the Lymph and Blood during Immediate Type Hypersensitivity

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Combination therapy with hydrocortisone and norepinephrine improved resorption and transport functions of the lymphatic system during anaphylactic shock, which was accompanied by a considerable increase in the contents of total lipids, phospholipids, cholesterol, nonesterified fatty acids, and malonic dialdehyde (lipid peroxidation product) in the lymph and blood. It should be emphasized that lipid concentration in the lymph increased to a greater extent than in the blood.

Key Words: *lipids; lymph; anaphylactic shock; hydrocortisone; norepinephrine*

Our previous studies showed that the lymphatic system plays an important role in mobilization and redistribution of energy and plastic resources (lipids) in body fluids during immediate type hypersensitivity. Lipids mobilized during anaphylactic shock (AS) and released into interstitial fluid are then resorbed by lymphatic vessels [7]. However, increased lipid concentration in the interstitial space impairs drainage functions of the lymphatic system and decelerates transport in the blood-tissue-lymph-blood system, which aggravates microcirculatory disturbances and promotes accumulation of toxic metabolites in the interstitium. These data indicate that lymphotropic therapy of AS is of considerable importance.

MATERIALS AND METHODS

Experiments were performed on 16 mongrel male and female dogs weighing 6-22 kg and narcotized with thiopental (25 mg/kg intravenously). Sensitization and AS were modeled as described previously [7]. Clinical signs of shock developed in all animals. The lymph was obtained by cannulation of the thoracic lymphatic duct. Norepinephrine (10 μg/kg) and hydrocortisone (10 mg/kg) were injected intravenously 2 min after shock modeling. We measured the contents total lipids [3], triglycerides and cholesterol (Labsystems FP-901 analyzer), phospholipids [3], malonic dialdehyde (MDA) [11], and free fatty acids (FFA) [5] in the lymph and venous blood. The animals were euthanized by narcotic overdose.

The results were processed statistically [6,9].

RESULTS

Treatment with norepinephrine and hydrocortisone during AS was accompanied by marked changes in the lipid composition of the lymph and blood (Table 1). Lipid content in the lymph and venous blood increased by 100-150 and 100% of the baseline level, respectively. In untreated animals the increase in total lipid content in the lymph persisted for a shorter period and did not exceed 20-40%.

FFA concentration in the lymph and venous blood underwent more pronounced changes. The content of FFA increased by 150-200% over the first 10-30 min

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TABLE 1. Effect of Norepinephrine and Hydrocortisone on Lipid Composition of the Lymph (Numerator) and Blood (Denominator) in Dogs with AS (*M*±*m*)

Parameter	Before administration of the antigen in a permissible dose	After administration of the antigen in a permissible dose, min		
		10	30	60
Total lipids, g/liter	2.84±0.33 3.18±0.24	4.62±0.42*** 4.78±0.41	7.38±0.47** 5.98±0.56***	6.67±0.37** 5.57±0.25***
Phospholipids, mmol/liter	2.69±0.16 3.28±0.10	2.28±0.20*** 2.55±0.19	3.47±0.24 4.79±0.30	3.91±0.44 4.86±0.34
Triglycerides, mmol/lipids	3.22±0.25 0.30±0.02	0.83±0.04*** 0.43±0.09	1.00±0.05 0.63±0.07	1.74±0.08** 0.93±0.04***
Cholesterol, mmol/liter	1.95±0.15 2.61±0.14	2.38±0.20*** 3.33±0.12***	2.87±0.13*** 3.18±0.29***	2.70±0.28*** 3.73±0.12***
MDA, nmol/liter	6.26±0.23 5.88±0.62	10.8±1.50*** 9.70±0.64**	14.32±1.33** 11.04±1.61***	15.35±1.17* 12.62±1.22**
FFA, mmol/liter	295.85±27.21 198.57±7.39	734.14±60.42** 417.57±41.09*	869.14±49.17* 446.57±48.48*	787.14±88.60*** 387.00±49.31

Note. *p<0.001, **p<0.01, and ***p<0.05 compared to untreated animals.

after the incidence of AS and administration of preparations. In dogs receiving norepinephrine and hydrocortisone FFA concentration in the lymph during AS increased to a greater degree than in untreated animals (20-95% of the baseline level).

We previously showed that AS was not accompanied by considerable changes in cholesterol concentration in the lymph, but decreased this parameter in the venous blood [7]. Cholesterol content in the lymph and blood increased after combination therapy with hydrocortisone and norepinephrine. MDA concentration sharply increased to 200% of the baseline level. It should be emphasized that in the lymph these changes developed earlier, were more pronounced (up to 250%), and persisted for a longer period than in the venous blood (Table 1).

Hydrocortisone and norepinephrine affected qualitative and quantitative changes in lymph phospholipids during AS. In dogs receiving these preparations the increase in lymph phospholipid content was more pronounced, but persisted for a shorter period than in untreated animals.

Corticosteroids protect cells from aggressive substances formed in the reaction between antigens and antibodies, improve microcirculation, and block the release of lysosomal enzymes [2,10]. Many agents used for the therapy of shock increase lipolytic activity in tissues. Mobilization of lipids from lipid stores prevents energy deficiency, whose severity increases with the progression of shock [4]. Most hormones affecting lipid metabolism (*e.g.*, epinephrine, thyroxine, and hydrocortisone) intensify lipolysis [1,12]. The increase in total lipid and FFA contents in the lymph and blood is probably associated with the lipolytic effect of hydrocortisone and norepinephrine. It should be emphasized that lipid concentration first increases in the lymph.

Combined treatment with norepinephrine and hydrocortisone is followed by a considerable increase in lymph flow rate in the thoracic lymphatic duct [8] and release of cholesterol and lipid peroxidation products from the intercellular space.

Our results show that hydrocortisone and norepinephrine stimulate resorption and transport functions of the lymphatic system, improve transport of cellular metabolic products from the interstitial space through lymphatic vessels, increase lipid content in the lymph and blood, and maintain lipid metabolism in the organism.

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