ALLERGOLOGY

Correction of Lymph Circulation during Immediate Hypersensitivity Reaction

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We measured lymph flow rate in the thoracic lymphatic duct of dogs with anaphylactic shock receiving mono- or combination therapy with norepinephrine and hydrocortisone. Intensification of lymph circulation improved resorption and transport of metabolic products from the interstitial space through lymphatic vessels and stimulated exchange processes in the blood and tissues during allergic alterations.

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

Dysfunction of the lymphatic system determines the outcome of many diseases independently on their etiology and pathogenesis. Functional correction of the lymphatic system, stimulation of lymph circulation, and lymphotropic therapy attract much recent attention [1-3,8]. During allergic alterations, in particular, anaphylactic shock (AS) systemic metabolic disorders, formation and release of vasoactive substances, neurovegetative and hormonal discoordination, disturbances in external respiration and hemodynamics, and changes in the blood system promote the impairment of lymph flow and transport.

Here we measured lymph flow rate in the thoracic lymphatic duct (TLD) of dogs during sensitization and AS and evaluated the effects of hydrocortisone and norepinephrine on lymph circulation in animals with AS.

MATERIALS AND METHODS

Experiments were performed on 32 mongrel healthy male and female dogs weighing 6-22 kg. The animals were sensitized by repeated (3 times) subcutaneous injections of normal horse serum in a dose of 0.3 ml/kg. AS was induced by intravenous administration of the antigen in a permissible dose. Clinical signs of AS developed in all animals. The dogs were anesthetized with sodium thiopental (25 mg/kg intravenously). The lymph was obtained by cannulation of TLD. Lymph flow rate was estimated by lymph flow through a cannula over 1 min. Norepinephrine (10 μg/kg) and hydrocortisone (10 mg/kg) were injected intravenously 2 min after shock induction. The animals were euthanized by the narcotic overdose. The results were analyzed statistically [5,7].

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RESULTS

Lymph flow rate in TLD did not differ from the control under conditions of antigenic stimulation (0.452± 0.064 μl/kg/sec), but changed during AS (Table 1). Lymph flow rate increased by 4, 2, 1.7, and 1.2 times 10, 30, 60, and 120 min after treatment with the antigen in a permissible dose, respectively.

High vascular permeability, increased amplitude and rate of respiration, progressive hypotonia, secretion of corticosteroids and catecholamines, and massive release of biologically active substances probably contribute to an increase in the lymph flow rate.

Despite the marked increase in the lymph flow rate, AS was accompanied by disturbances in lymph circulation due to the impairment of neurohormonal mechanisms regulating resorption and transport of pro-

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TABLE 1. Effects of Norepinephrine and Hydrocortisone on Lymph Circulation in Thoracic Lymphatic Duct in Dog with AS (μl/kg/sec, *M*±*m*)

Period	AS			
	no correction	+norepinephrine	+hydrocortisone	+norepinephrine and hydrocortisone
Before treatment with the antigen in a permissible dose	0.603±0.048	0.572±0.057	0.528±0.037	0.560±0.114
After treatment with the antigen in a permissible dose, min				
7-10	2.707±0.501**	2.920±0.405*+	3.205±0.142*+	3.528±0.167*+
30	1.209±1.145***	1.820±0.204**+	2.417±0.163*+	3.696±0.180*+
60	1.018±0.207***	1.010±0.115***	1.624±0.172*	2.800±0.165*+
120	0.750±0.140	0.804±0.124***	1.218±0.109*	1.512±0.104*

Note. *p<0.001, **p<0.01, and ***p<0.05 compared to dogs before treatment with the antigen in a permissible dose; +p<0.01 compared to untreated dogs.

tein-containing fluid in lymphatic vessels (LV). Under pathological conditions highly dilatable LV can deposit a considerable amount of fluids which increases the severity of circulatory disturbances [4]. Thus, stimulation of lymph circulation during AS is very important.

Norepinephrine and hydrocortisone stimulated lymph circulation under normal conditions and during AS. Hydrocortisone produced a more prolonged increase in the lymph flow rate in TLD than norepinephrine (Table 1). During combined treatment with norepinephrine and hydrocortisone the increase in the lymph flow rate persisted for a longer period and was more pronounced than that observed after individual administration of these preparations.

A considerable increase in the lymph flow rate induced by hydrocortisone is probably related to hemodynamic changes, enhancement of contractile activity of LV, and stimulation of β-adrenoceptors in the vascular wall. Vasoconstriction associated with activation of α-adrenoceptors in LV wall is accompanied by vasodilation due to stimulation of β-adrenoceptors. Dilation of LV and stimulation of contractile activity of smooth muscles in their wall lead to a marked increase in the lymph flow rate. Hydrocortisone initially affects transport functions of the lymphatic system (30 min postinjection) and then modulates lymph formation, which manifested in the increase in total lymph protein content. Moreover, hydrocortisone suppresses activation of the kinin system and abolishes the increase in histamine content in the blood and lymph during AS [6]. Combined treatment with hydrocortisone and norepinephrine promotes the cardiotonic and pressor effects of norepinephrine, improves hemodynamic parameters, increases pulse pressure, and normalizes central venous pressure [9].

Our results suggest that glucocorticoids and catecholamines intensify lymph circulation during AS, which improves resorption and transport of the protein fluid and metabolic products from the interstitial space through LV and stimulates exchange processes in the blood and tissues during allergic alterations.

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