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PROPERDIN AND THE PROTEIN COMPOSITION OF THE LYMPH AND BLOOD DURING RESUSCITATION

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UDC 616-036.882-08-07:616.153.96-074

Experiments on dogs showed that terminal blood loss followed by resuscitation by injection of autologous blood into the bone marrow causes a regular redistribution of proteins between the blood, limbs, and tissues. Retention of properdin and α-globulins is observed in the interstitial tissue and is not abolished by the resuscitation measures; a stress discharge of γ-globulins is also found from the lymph nodes.

KEY WORDS: *properdin; proteins; lymph; resuscitation.*

The properdin content and protein composition of the lymph and blood were studied before and after resuscitation of dogs from clinical death caused by acute massive blood loss.

EXPERIMENTAL METHOD

Experiments were carried out on 19 dogs of both sexes weighing 15 ± 5 kg. Under thiopental anesthesia the thoracic duct and cervical lymphatic trunk were cannulated. In 12 dogs a terminal state was induced by free bleeding from the femoral artery up to the extent of 60 ml/kg body weight. Resuscitation was started 1-3 min after the onset of clinical death (as shown by spirography, electrocardiography, and measurement of the arterial blood pressure) by injection of autologous blood, stabilized with sodium citrate, into the bone marrow until normal respiration, cardiac activity, and blood pressure were restored. Samples of lymph and blood were taken before and 3 h after bleeding and subsequent reinfusion. Seven dogs served as the control. The properdin concentration was determined by binding it with inulin, followed by mineralization of the properdin—inulin complex and isometric distillation of ammonia in Conway dishes; the protein composition was studied by electrophoresis in agar gel. The results were subjected to statistical analysis by the Nairi-2 computer.

EXPERIMENTAL RESULTS

The results are given in Table 1. After resuscitation the properdin level was found to be lowered in the blood (by 23.4%), and the thoracic (by 18.9%) and cervical lymph (by 28.1%) of the experimental dogs. This decrease probably indicates retention of properdin in the tissues and not its redistribution between the blood and lymph. The writers previously found

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(Presented by Academician of the Academy of Medical Sciences of the USSR P. D. Gorizontov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 84, No. 7, pp. 24-26, July, 1977. Original article submitted December 24, 1976.

TABLE 1. Properdin and Protein Composition of Lymph and Blood of Dogs before and after Resuscitation (M ± m)

Index studied	Values obtained in		
	blood serum	cervical lymph	thoracic lymph
	Before bleeding		
Properdin, μg/ml	22,2±1,31	9,0±0,45	13,0±0,69
Total protein, g%	6,7±0,07	2,51±0,11	4,09±0,14
Albumins, g%	2,99±0,05	1,29±0,05	2,19±0,09
Globulins, g%			
α_1	0,73±0,03	0,21±0,01	0,35±0,01
α_2	1,14±0,03	0,25±0,01	0,41±0,02
β	1,16±0,04	0,49±0,03	0,75±0,03
γ	0,71±0,02	0,25±0,01	0,36±0,01
	After bleeding		
Properdin, μg/ml	17,2±1,42	6,5±0,31	10,5±0,32
P	<0,01	<0,01	<0,01
Total protein, g%	5,48±0,16	2,32±0,09	4,42±0,11
P	<0,01	<0,01	<0,1
Albumins, g%	2,59±0,08	1,19±0,04	2,24±0,06
P	<0,01	<0,01	>0,5
Globulins, g%			
α_1	0,46±0,02	0,18±0,01	0,44±0,02
P	<0,001	<0,01	<0,01
α_2	0,63±0,03	0,22±0,01	0,61±0,01
P	<0,001	<0,01	<0,01
β	1,04±0,04	0,42±0,02	0,70±0,03
P	<0,05	<0,01	>0,05
γ	0,72±0,04	0,29±0,01	0,41±0,01
P	>0,5	<0,01	<0,05

similar retention of properdin in the tissues after burns and radiation and traumatic injuries, and also during infections [3, 4], on account of the binding of properdin by glycoprotein and mucopolysaccharide tissue destruction products, the content of which in the tissues rises after injury [1, 6, 7].

The increase in the total protein concentration in the blood serum (by 18.3%) could be partly attributed to the hydremia arising as a result of the entry of tissue fluid into the bloodstream. Evidence of this is given by the acceleration of the lymph flow, judged from the number of drops of lymph escaping from the cannula per minute. The decrease in the protein concentration in the blood serum may reflect a disturbance of capillary permeability after resuscitation, during which the transfer of finely dispersed proteins from the blood into the tissue fluid increases. In fact, the blood levels of all protein fractions except coarsely dispersed γ-globulins were reduced. It is interesting to note that whereas the decrease in the fractions of albumins (by 13.4%) and β-globulins (by 10.4%) in the blood was relatively proportional to the decrease in the total protein concentration, the decrease in the α-globulin concentration (by 41.8%) was much more marked. Highly active carbohydrate-containing proteins of the α fraction are evidently much more strongly bound in the tissues under conditions of hypoxic injury and they are returned to the bloodstream from the lymphatic system to a much lesser degree.

Only a tendency for the total protein concentration to rise was observed in the thoracic duct lymph of the animals after resuscitation. However, if the dilution of the lymph by tissue fluid is taken into account, this increase must be fairly considerable. The increase in the protein concentration in the thoracic lymph was evidently due to the liberation of glucocorticoids, stimulating lymphogenic resorption [5], as the result of stress. The predominance of the glucocorticoid background in the early stages of stress was also probably responsible for the absolute increase in the concentration of γ-globulins in the thoracic (by 13.8%) and cervical (by 16%) lymph, for these globulins are liberated by plasmacytolysis [2]. The composition of the lymph in the thoracic duct is known to be largely determined by the hepatic lymph. An increase in the α-globulin fraction (by 38.1%) in the thoracic lymph is thus evidence of preservation of the function of the liver, which synthesizes the proteins of this fraction, under the conditions of hemorrhagic and resuscitation stress. This shows once again that the decrease in the blood α-globulin level in the present experiments was not due to a disturbance of the protein-synthesizing function of the liver, but to their retention in the

interstitial tissues. The binding of properdin, which has affinity for glycoprotein structures, which most α-globulins are, in the tissues is therefore all the more interesting.

Special attention must be paid to changes in the protein composition of the cervical lymph during resuscitation. In 9 of the 12 experimental dogs the total protein level in the cervical lymph was reduced and in three it was increased. The total protein concentration fell on account of an equal decrease in all fractions except γ-globulins, the concentration of which in all cases increased, causing actually an increase in the total protein concentration in the cervical lymph of three dogs. A similar increase in the γ-globulin concentration also has been observed after experimental administration of cortisone [5].

In the control dogs no significant changes in the properdin level or protein composition of the lymph and blood were observed in the course of the investigation.

Terminal blood loss followed by resuscitation is thus accompanied by a regular redistribution of proteins between the blood, lymph, and tissues. Hemorrhagic injury causes retention of properdin and α-globulins in the tissues, which is not abolished by resuscitation measures; liberation of γ-globulins from the lymph nodes under the influence of stress, probably aimed at compensation of the disturbances which have arisen under the influence of stress, is also found.

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