DISTURBANCES OF VASCULAR PERMEABILITY IN SHOCK (ELECTROPHORETIC INVESTIGATION OF PROTEIN COMPOSITION OF THE LYMPH IN DEVELOPMENT OF PEPTONE SHOCK)

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It was shown in previous investigations [1, 2] that during peptone shock in dogs the elimination of intravenously administered labeled protein from the blood and its appearance in the lymph of the thoracic duct were accelerated. These data suggested that peptone shock was associated with changes in vascular permeability. Further elucidation of this question was undertaken with the help of studies on the protein composition of the blood and lymph during the development of peptone shock.

EXPERIMENTAL METHODS

Experiments were performed on dogs of both sexes and different weight. The femoral vein was dissected under morphine-ether anesthesia and used for injection of peptone solution; the femoral artery was used for recording blood pressure. A cannula was inserted into the thoracic lymph duct.

The blood and lymph for electrophoretic analysis were received into dry centrifuge tubes; the samples were collected before administration of peptone and 5 minutes after its injection.

Shock was produced by intravenous injection of 40% solution of peptone prepared with 0.85% sodium chloride solution, the dose being calculated to correspond to 0.7 g peptone per 1 kg body weight. Experiments were carried out on 17 dogs. Development of shock was monitored by measurement of blood pressure in the femoral artery. The blood pressure, as a rule, fell by $^2/_3$ of the initial value within 20-30 seconds after administration of peptone.

The total blood serum and lymph protein was determined by means of an immersion refractometer "IRF-1". Determination of the protein composition of the blood and lymph was carried out in part of the experiments by the electrophoretic method using the apparatus constructed in our laboratory, incorporating the optic arrangement proposed by G. V. Troitsky [6, 7]. Veronal buffer (pH = 8.6 at 20°; 0.1 M) was used. In many experiments the study of protein composition of the lymph by classic (free) electrophoresis was rendered difficult by insufficient transparency of the lymph. Therefore the majority of determinations were performed by means of filter-paper electrophoresis. Separation time – $4^1/_2$-5 hours with current strength 1 ma per 4 cm of paper width and voltage 7-8 v/cm, M = 0.46, pH = 8.6. The electrophoregrams were developed by 0.5% solution of bromphenol blue in concentrated alcoholic solution of mercuric chloride. The details of electrophoretic technic are described in the work of E. P. Smolichev [4, 5].

EXPERIMENTAL RESULTS

Statistic treatment of results obtained in 7 experiments with free electrophoretic determination of protein fractions showed that, in dogs, 5 minutes after the administration of peptone there was an increase in the concentration of protein in the lymph of the thoracic duct ($P < 0.001$), while the ratios of the protein fractions and

the value of the A/G coefficient remained unchanged ($P > 0.05$).

Statistically treated results of 10 experiments using filter paper electrophoresis are presented in Tables 1 and 2.

TABLE 1

Concentration of Protein (in Grams-Per Cent) and Ratios of Protein Fractions (in Relative Percentages) in Dog Blood Serum During Development of Peptone Shock

Statistic indices	Protein in g%	Albumin	Globulins					A/G
			α_1	α_2	β_1	β_2	γ	
			Before shock					
M	6.8	49.3	7.3	6.4	8.3	16.2	11.8	0.9
$\sigma\pm$	—	6.7	2.4	2.3	5.7	5.5	5.1	0.3
$m\pm$	—	2.1	0.7	0.7	1.1	1.7	1.6	0.09
			During shock					
M	6.6	51.4	7.1	6.4	6.3	15.6	13.0	1.1
$\sigma\pm$	—	8.2	1.4	2.8	2.7	7.7	7.7	0.85
$m\pm$	—	2.6	0.7	0.9	0.8	2.4	2.4	0.1

TABLE 2

Concentration of Protein (in Grams-Per Cent) and Ratios of Protein Fractions (in Relative Percentages) in Dog Lymph Serum During Development of Peptone Shock

Statistic indices	Protein in g%	Albumin	Globulins					A/G
			α_1	α_2	β_1	β_2	γ	
			Before shock					
M	3.4	61.2	6.2	5.1	4.7	8.9	12.7	1.6
$\sigma\pm$	1.1	7.7	2.9	2.7	1.6	4.0	6.6	0.6
$m\pm$	0.3	2.1	0.9	0.8	0.5	1.2	2.1	0.2
			During shock					
M	4.7	60.0	5.9	6.3	4.1	10.0	13.5	1.5
$\sigma\pm$	1.2	9.2	2.0	4.2	1.9	3.9	11.0	0.5
$m\pm$	0.3	2.9	0.6	1.3	0.6	1.2	3.5	0.2

Table 1 shows that 5 minutes after intravenous injection of peptone there were no changes ($P > 0.05$) in the concentration of protein, ratios of protein fractions and the A/G coefficient of blood serum in dogs.

Data presented in Table 2 demonstrate that 5 minutes after intravenous injection of peptone there is a rise in protein concentration of the lymph in the thoracic duct ($P < 0.001$) but no change ($P > 0.05$) in the ratios of protein fractions and the A/G coefficient.

DISCUSSION

Studies of capillary permeability by modern methods do not always reveal the development of general disturbances of permeability. Thus, M. Netsky and S. S. Leiter [11] found that intravenously injected horse serum protein appeared in the lymph of the thoracic duct more rapidly in dogs suffering from shock due to burns than in control animals. At the same time O. Cope and F. Moore [9], J. Fine and A. Seligman [10] demonstrated only local disturbances of capillary permeability in cases of shock due to burns. General disturbances of vascular permeability could not be demonstrated in rats suffering from hemorrhagic shock (R. Baratz and R. Ingraham [8]) and in dogs in ischemic shock (G. Szabo and L. Madyar [12]). In a recently published paper G. Szabo and L. Madyar [13] report that general disturbances of capillary permeability in histamine shock can be demonstrated in dogs but not in cats. Evidently, general disturbances of vascular permeability cannot be regarded as a state characteristic for all types of shock and underlying the pathogenesis of shock of various origin (I. A. Olvin [3]).

The present investigations show that in peptone shock the passage of proteins from the blood into the tissues is accelerated, the appearance of labeled protein in the lymph of the thoracic duct is also accelerated, the concentration of protein in the lymph is increased, but there is no change in the ratio of the blood and lymph protein fractions. The absence of change in the protein composition of the blood is easily explained. Under the influence of peptone lymph production and lymph flow are enhanced. The proteins are not retained in the tissues but enter the blood by way of the lymphatics. Therefore the concentration of protein in the blood does not alter. The enhanced passage of proteins from the blood into the lymph in peptone shock is not selective. All the protein fractions pass through the capillaries at the same rate. This is attested by the absence of changes in the ratio of the protein fractions in the lymph during development of peptone shock. There is thus no basis for speaking of selective disturbances of capillary permeability in peptone shock. The data obtained indicate an increase of overall [3] capillary permeability during the development of peptone shock.

SUMMARY

Peptone shock is developed in 5 minutes following the intravenous injection of peptone. There is an acute decrease in the blood pressure. There were no changes in the protein concentration and in the relationship between the protein fraction of the blood serum. A pronounced increase of the lymph flow with increased concentration of the protein in the lymph of the thoracic duct was noted. The average value of the protein concentration before the introduction of peptone equalled 3.5, $m \pm 0.11$ g%; following peptone introduction it was 4.7, $m \pm 0.2$ g%; ($P < 0.01$).

There were no changes in the relative content of the protein fractions of the lymph.

In dogs there is an increased permeability of the blood capillaries in peptone shock but they remain intact.

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