PLASMA RENIN AND ERYTHROPOIETIC ACTIVITY AFTER REDUCTION OF THE EXTRACELLULAR VOLUME

N. Nachev, P. Logofetov,
N. Tsaneva, and L. Iordanova

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The effect of a decrease in the extracellular volume (by peritoneal dialysis with 10% glucose) on the plasma renin and erythropoietic activity and also on the renin activity of the renal cortex was investigated. The renin and erythropoietic activity of the experimental animals was considerably increased. It is suggested that renin and erythropoietin are two components of a single regulatory system ensuring the optimal oxygen supply to the tissues.

KEY WORDS: *renin; erythropoietin; extracellular volume; oxygen supply to the tissues.*

A decrease in the extracellular volume (ECV) in dogs leads to an increase in the plasma renin activity [1, 4, 6]. Blood loss is also known to stimulate the plasma erythropoietic activity [8]. However, it is not clear whether this effect is connected with hypoxia or with hypovolemia.

The object of this investigation was to study the effect of a reduction in ECV on the plasma renin and erythropoietic activity and also on the renin activity in the renal cortex.

EXPERIMENTAL METHOD

Experiments were carried out on 116 male Wistar rats with a mean weight of 200 ± 2 g.

The experimental animals were given an intraperitoneal injection of 10% glucose solution in a dose of 5% of the body weight (to reduce the ECV). The sodium concentration in a sample of dialysate was measured 30 min later by means of a flame photometer.

Blood samples from the carotid artery and the right ventricle were taken from the control and experimental rats, anesthetized with pentobarbital (0.3 mg/100 g body weight, intraperitoneally) after clamping of the renal vessels on both sides. The blood was taken with a syringe that had been previously cooled and washed with 6% EDTA-Na_2 solution, after which it was centrifuged at 4°C and the plasma kept at −10°C until required for investigation.

The plasma renin activity in blood samples from the carotid artery was estimated by a biological method [3]. For this purpose, the effect of angiotensin-2 (obtained by incubation of the plasma for 4 h at 37°C and pH 6.5 in the presence of neomycin sulfate) and of standard solutions of hypertension (Ciba) on the pressure in the carotid artery of rats after preliminary division of the vagus nerves in the neck and injection of anzolizin* (0.5 mg/100 g) and atropine (0.1 mg/100 g) was compared. The test and standard solutions were injected intravenously in a volume of 0.1 ml. The results were expressed in nanograms of angiotensin-2 (A-2) per milliter of plasma tested. Angiotensin-1 (A-1), obtained by incubation

*Taken to be Ansolysen (pentolinium tartrate) – Translator.

Department of Physiology, Medico-Biological Institute, Medical Academy, Sofia, Bulgaria.
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TABLE 1. Effect of Reduction in ECV (by peritoneal dialysis) on Indices of Renin and Erythropoietic Activity in Rats (M ± m)

Index	Control	Experiments
Hematocrit	45,2±3,1 (18)	50,9±4,0 (18)
Plasma Na, meq/liter	147±5,9 (4)	142±2,8 (4)
Concentration of A-1, ng/ml	60,9±6,2 (19)	165,7±24,7 (8)
Concentration of A-2, ng/ml	33,2±2,4 (12)	52,4±0,4 (14)
Incorporation of ^{59}Fe into erythrocytes, %	21,9±0,9 (19)	27,7±0,8 (18)
Renal renin activity, ng A-2/g	184,2±11,7 (9)	268,9±17,3 (17)

Legend. Number of animals in parentheses.

of the plasma for 2 h at 37°C and at pH 6.5, was determined in blood samples from the heart by a radioimmunological method using kits obtained from the firm Sorin. Renin activity in the renal cortex of the control and experimental animals was estimated by the biological method described above. The results were expressed in nanograms of A-2 per grams of tissue during incubation for 10 min with plasma at 37°C.

The index of the plasma erythropoietic activity was the incorporation of ^{59}Fe into erythrocytes 24 h after intraperitoneal injection of ^{59}Fe ascorbinate in a dose of 1 μCi into the rats. The ^{59}Fe was injected into the experimental rats 24 h after peritoneal dialysis. The hematocrit index was measured in blood taken from the caudal vein.

EXPERIMENTAL RESULTS AND DISCUSSION

The experimental results are given in Table 1.

The mean sodium concentration in the dialysate was 99 ± 4.4 meq/liter, evidence of a decrease in the volume of extracellular fluid in the experimental animals by about 15%. This was also shown by a decrease in the plasma sodium level and an increase in the hematocrit index.

The results indicate that changes in the renin and erythropoietic activity of the plasma in animals after a reduction in ECV are in the same direction.

These changes, in the writers' view, reflect the same adaptive reaction of the body, aimed at improving the oxygen supply to the tissues. Stimulation of the renin activity of the kidneys and plasma restricts glomerular filtration and causes secondary activation of the aldosterone mechanism (unpublished data), which leads to retention of sodium and water in the body. This restores the effective volume of the circulation, and thus maintains an optimal perfusion pressure in the various organs. The increase in erythropoietic activity creates the conditions for an increase in the oxygen transport to the tissues.

The results, like those obtained by other workers [5], suggest that renin and erythropoietin are two closely linked components of a single complex regulatory system, which ultimately maintains the optimal oxygen supply to the tissues.

This hypothesis is confirmed by the writers' other findings, according to which the renin and erythropoietic activities of the plasma are stimulated by the same factors; moreover their regulation is linked with the posterior hypothalamus and the sympathetic division of the autonomic nervous system [2, 7].

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EFFECTIVENESS AND ADAPTATION TO FOOD QUALITY OF THE STARCH-GLUCOSE CONVEYOR AFTER LIGATION OF THE BILE AND PANCREATIC DUCTS IN RATS

G. I. Loginov

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Membrane hydrolysis and carbohydrate transport were determined in different segments of the small intestine of rats 2 h after the animals had been fed with bread or meat, on the 4th, 7th, and 14th days after ligation of the bile and pancreatic ducts. The results showed that even when the amylolytic activity of the mucosal surface was sharply reduced, the transport of glucose liberated during contact hydrolysis of starch was inhibited to a much lesser degree. For 2 weeks the intensity of transport of starch glucose rose sharply in preparations from the intestine of rats fed on bread but fell in rats fed on meat. The differences between the levels of hydrolysis of starch and transport of free glucose in the rats of the two groups were not significant.

KEY WORDS: *contact digestion; carbohydrates; ligation of the bile and pancreatic ducts.*

The hypothesis of the digestive transport conveyor as a structural-functional system of the enterocyte [5-7] affords fresh opportunities for the study of the adaptive reactions of the small intestine. It has been shown, in particular, that the mechanism of coupling of hydrolytic and transport processes not only ensures the high efficiency of work of the digestive system, but also plays an important role in adaptive reactions [1, 3-6]. The participation of a coupling mechanism in the adaption of the starch-glucose conveyor to food quality after a single feeding was demonstrated previously [2] in intact rats. Considering the changes in the regulatory properties of the enterocytes in certain forms of pathology [7, 8], it was decided to study the adaptive reactions of the systems of membrane hydrolysis and transport against the background of various food stimuli after disturbance of luminal digestion.

Digestive and transport activity of the intestinal epithelium was investigated in rats after ligation of the bile and pancreatic ducts.

EXPERIMENTAL METHOD

Adult rats were kept on a mixed diet and, after starvation for 18-20 h, they were fed with bread or cooked meat. The rats were decapitated 2 h after the beginning of feeding. The level of membrane hydrolysis and of carbohydrate transport was determined in the proximal, middle, and distal segments of the small intestine.

Hydrolysis of sucrose and soluble starch (2% solution) in everted pieces of small intestine was determined by a modified Nelson's method [8, 10]. Absorption was studied with the aid of accumulating preparations of the mucosa [9], which were incubated in an 11.1 mM

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