# EFFECT OF ALDOSTERONE, VASOPRESSIN, AND SODIUM-EXCRETING FACTOR ON ABSORPTION IN THE RAT JEJUNUM

R. B. Kosuba and Yu. I. Ivanov

UDC 612.332.7-06:[612.453+612.434'14].018

Experiments on everted pouches of rat jejunum showed that on the addition of blood plasma containing sodium-excreting factor the concentration of sodium-excreting factor is bound to be inversely proportional to the intensity of absorption in the rat jejunum, but no such relationship is observed with aldosterone and vasopressin.

KEY WORDS: expansion of the extracellular space; transport function of the jejunum; sodium-excreting factor; aldosterone; vasopressin.

During expansion of the extracellular space the reabsorption of sodium and water is inhibited in the proximal renal tubules as a result of the action of a sodium-excreting factor (SEF), liberated into the blood stream in response to stimulation of volume receptors [2, 7], on them. Experiments in vivo have shown that SEF can modify the absorption of water and electrolytes in the gastrointestinal tract also [5, 8], and this fact also plays an important role in the maintenance of the water and electrolyte balance in the body.

It was accordingly decided to compare the effect of SEF with that of other known neurohumoral agents participating in the regulation of the water and salt balance of the body (vasopressin, aldosterone) on the transport function of the epithelium of the rat small intestine.

## EXPERIMENTAL METHOD

Male rats weighing 180-220 g were deprived of food for 18-22 h before the beginning of the experiment but received water ad lib. After decapitation of the rats, two segments each 5 cm long were isolated from the upper proximal part of the jejunum. The transport function was investigated in isolated everted segments of intestine [10]. The everted pouches were incubated for 2 h in 10 ml of Krebs' bicarbonate solution (composition in mM): NaCl 135, KCl 4.5, $CaCl_2$ 2.5, $MgSO_4$ 1.18, $NaH_2PO_4$ 1.84, $Na_2HPO_4$ 0.46; glucose 12.2 M, at 37°C, pH 7.4, with constant aeration of the medium. This is the best solution for studying transport function in the intestine [9]. Considering that the absorption of sodium by the intestinal wall is equimolar with the absorption of water [4], the transport function of the intestinal epithelium was judged from the change in weight of the everted segment of intestine. The weighing was carried out every 30 min (the first 30 min, as the period of equilibration, was disregarded). After incubation the segment of intestine was dried to constant weight and changes in its weight per gram of dry tissue were calculated. Plasma containing SEF was obtained from the rats before and after the expansion of their extracellular space (by intravenous injection of 0.9% NaCl solution in a volume equivalent to 3% of the body weight). The transport function of the intestine was studied under the influence of the substances in the following concentrations: blood plasma 0.1 ml/10 ml, aldosterone (Serva, Heidelberg) $2 \cdot 10^{-7}$ M, and vasopressin (Koch-Light Laboratories, England) 1 unit/10 ml.

## EXPERIMENTAL RESULTS

Control experiments showed that the everted pouch of jejunum, under the conditions created, remained viable throughout the experiment. However, its transport function fell gradually with time (on average by 12-13% every 30 min).

Department of Pharmacology, Chernovtsy Medical Institute. (Presented by Academician of the Academy of Medical Sciences of the USSR V. V. Zakusov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 83, No. 6, pp. 704-706, June, 1977. Original article submitted November 17, 1976.

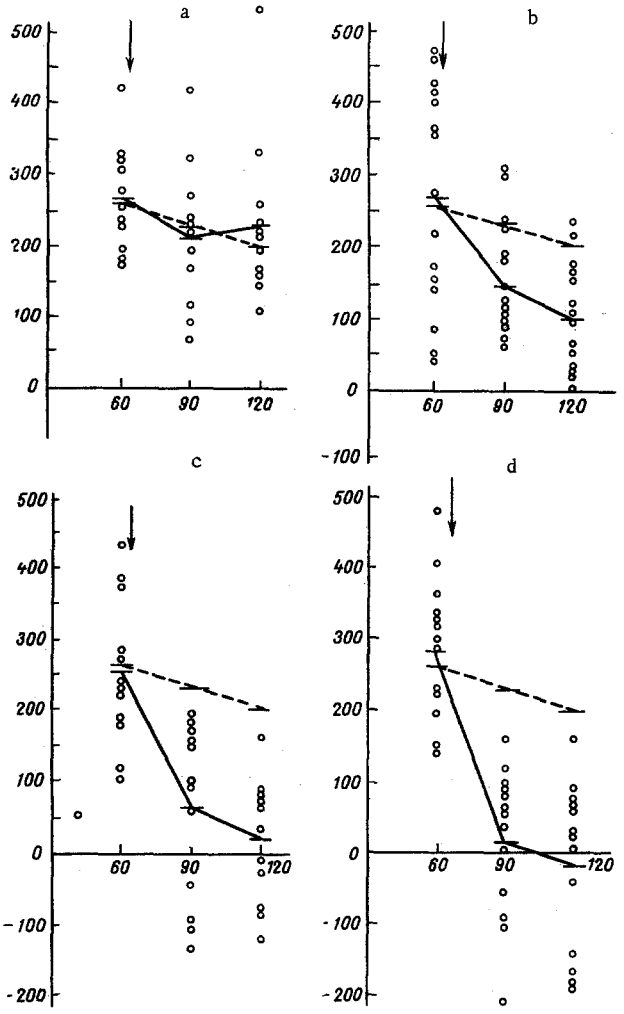


Fig. 1. Effect of aldosterone (a), vasopressin (b), blood plasma of intact animals (c), and blood plasma of animals after increase in their extracellular fluid volume (d) on transport function of segment of rat jejunum. Time of injection of preparation indicated by arrows; transport function of jejunum in control experiments shown by broken line. Circles indicate individual results. Continuous line gives mean values. Abscissa, incubation time (in min); ordinate, change in weight of segment of intestine (in mg/g dry weight).

On the addition of aldosterone to the nutrient medium (Fig. 1a) a very slight decrease in absorption was observed during the first 30 min, but by the end of incubation, on the contrary, absorption increased a little (on average by 17% compared with the control).

On the addition of vasopressin to the medium (Fig. 1b) absorption fell by a statistically significant degree ($P < 0.05$) both during the first 30 min (by 45.2%) and in the subsequent period (by 65.5%). Similar values have been obtained by other workers studying the frog gall bladder [3] and rat small intestine in experiments in vivo [1].

In the next series of experiments absorption in the small intestine under the influence of SEF was studied. For this purpose blood plasma of rats after expansion of their extracellular fluid volume was added to the incubation medium. Blood plasma of intact rats was used as the control. Ordinary rat plasma caused an appreciable decrease of absorption in the small intestine ($P < 0.001$) throughout the period of incubation (Fig. 1c). The same volume of plasma taken from the animals after expansion of their extracellular space not only reduced the absorption of fluid, but actually promoted its movement in the reverse direction from the serous to

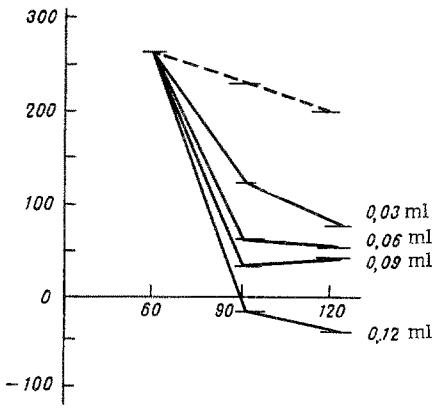


Fig. 2. Changes in transport function of segment of jejunum after addition of various quantities of blood plasma of animals to incubation medium after increase in their extracellular fluid volume. Legend as in Fig. 1.

the mucous layer (Fig. 1d), i.e., a decrease in the weight of the intestine was observed. This action can evidently be attributed to the presence of a larger quantity of SEF in the corresponding plasma. The results are in agreement with those obtained by other workers who found that under the influence of SEF not only is absorption into the intestine reduced in vivo, but there is actually an increase in the secretion of water and electrolytes into the lumen of the intestine [5, 6].

The next step was to discover how transport in the intestine is changed by the addition of different volumes of the animal's blood plasma after expansion of its extracellular space. The results (Fig. 2) are evidence that with an increase in the volume of plasma the gain in weight falls progressively. With large volumes of plasma, the weight of the segment of intestine was reduced, i.e., reversed transport of fluid was observed. This relationship was not found in experiments in which different volumes of plasma from intact rats, aldosterone, and vasopressin were added.

The effect of 0.1 ml of ordinary plasma on the transport of water and electrolytes was about equal to the effect of 0.06 ml plasma from animals in which the extracellular fluid volume had first been expanded, i.e., the SEF concentration in that plasma was almost twice that present in the blood plasma of intact animals.

After the addition of blood plasma containing SEF, the concentration of SEF was thus found to be inversely proportional to the intensity of absorption in the rat jejunum, although no such relationship was observed for aldosterone and vasopressin.

## LITERATURE CITED

1. N. Sh. Amirov and K. Freide, in: Proceedings of the Second All-Union Symposium on the Physiology and Pathology of Absorption in the Gastrointestinal Tract [in Russian], Odessa (1973), p. 3.
2. Yu. I. Ivanov, Fiziol. Zh. SSSR, No. 1, 103 (1972).
3. M. S. Yaremenko and I. A. Butusova, in: Proceedings of the Second All-Union Symposium on the Physiology and Pathology of Absorption in the Gastrointestinal Tract [in Russian], Odessa (1973), p. 148.
4. J. M. Diamond, J. Gen. Physiol., 48, 15 (1964).
5. J. T. Higgins and P. Norman, J. Clin. Invest., 50, 2569 (1971).
6. M. H. Humphreys and L. E. Earley, J. Clin. Invest., 50, 2355 (1971).
7. F. C. Rector, et al., J. Clin. Invest., 47, 761 (1968).
8. G. Richet and A. Hornych, Nephron, 6, 365 (1969).
9. D. H. Smith and C. B. Taylor, J. Physiol. (London), 136, 632 (1957).
10. T. H. Wilson and G. Wiseman, J. Physiol. (London), 123, 116 (1954).