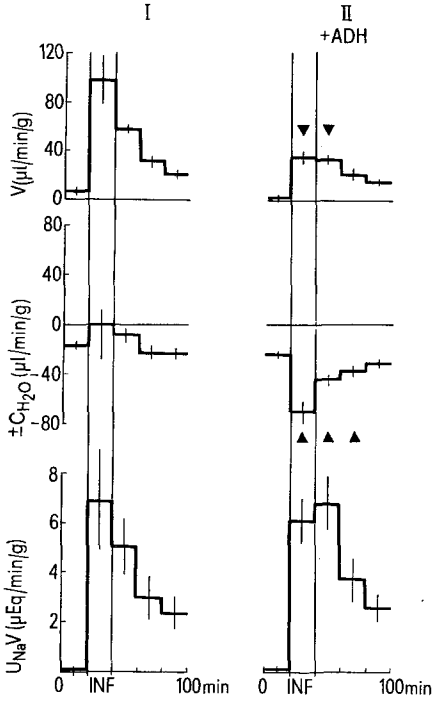
On the Role of Antidiuretic Hormone in Volume Natriuresis and Polyuria in Rats

It has been shown by DE WARDENER, MILLS et al.[1] and by other investigators that homeostatic natriuresis and polyuria following the extracellular fluid volume expansion with isoosmotic saline, is statistically significant and biologically important, even if the level of exogenous antidiuretic hormone (ADH) in plasma is increased. Continuous infusion of 'small' doses of ADH has since then widely been used in studies of renal response to saline load, with the aim of eliminating a possible non-specific natriuretic effect of an increased distal tubular load under the conditions of expected dilution and/or reflex diminution of the endogenous ADH release during the extracellular fluid volume expansion. However, on the other hand, it has been demonstrated that ADH itself can increase renal sodium excretion[2–4]. This problem has been reexamined in the present work by comparing the volume natriuresis, polyuria and some other related parameters in saline loaded rats without and with ADH infusion in order to find out to what extent exogenous ADH influences renal response to a moderate extracellular fluid volume expansion.

Material and methods. Five male Wistar rats (Velaz, Praha) weighing 220–250 g were anesthetized by i.p. applied Inactin (Promonta) 100 mg/kg body wt., surgically prepared (e.g. tracheotomized and carotid artery, jugular vein, femoral artery, femoral vein and urinary bladder cannulated with polyethylene catheters), heparinized and continuously infused inulin-^{14}C and vasopressin (Sandoz) 25μj/100 g body w.t./min.



The effect of a continuous infusion of ADH on volume natriuresis and polyuria. Statistically significant differences ($P < 0.05$ and less) between the corresponding urine sampling periods in (means ± S.E.) group of control rats (I) and the group of rats which were infused ADH during the extracellular fluid volume expansion with saline (II), are indicated with triangles. V, urine output in μl/min; ± CH_2O, clearance of the osmotically free water in μl/min; UNaV, sodium excretion in μEq/min; INF, period in which 0.9% saline was infused i.v. Medium of the kidney weigth was 1.84 g.

Following the surgical preparation, 1 h equilibration phase and the first urine sampling period (control), intravenous infusion of 0.9% saline in the amount of 4% of body wt. was completed in the second 20 min period. Later, 3 subsequent urine samples were taken at 20 min intervals. Blood samples for analysis were withdrawn in the middle of the first, third and the last period. Blood pressure was registered by a transducer and recorded by a polygraph (experimental group II). The results were compared with the previously partly published results[5] obtained in group of rats treated exactly in the same way but without the infusion of exogenous ADH (experimental group I). The differences in results were statistically evaluated by means of a Student *t*-test with the correction of *t*-criterion if the F values were significant[6,7].

Results and discussion. The results are summarized in the Figure. It was found that the volume polyuria (V) decreased significantly during a continuous infusion of ADH. This was caused by the increase of free-water reabsorbtion (group II). Renal sodium excretion was unaffected, as well as the pattern of inulin-^{14}C clearance, tubular sodium rejection fractions and blood pressures.

In conclusion, exogenous ADH in 'quasi physiological' doses did not influence volume natriuresis during moderate extracellular fluid volume expansion with saline in rats. Consequently, it does not seem important to apply ADH for the purpose of more adequate studies of volume natriuresis. As volume polyuria was diminished by ADH without any change in sodium excretion, it may also be concluded that urine output during isoosmotic extracellular fluid volume expansion is not solely dependent on the decreased proximal tubular reabsorbtion of sodium, but that urine excretion is at least partly regulated independently by ADH in the distal nephron. These findings, however, do not exclude a possibility that large doses of ADH could have influenced renal sodium excretion, as might have been the case in our previous experiments in which i.p. application of homogenates of neurohypophyses, containing large amounts of ADH, were used to restore volume natriuresis in hypophysectomized rats[5].

Zusammenfassung. An Ratten wird gezeigt, dass eine ADH-Infusion in niedriger Dosierung die Natriurese unter einer Belastung mit physiologischer NaCl nicht beeinflusst, während das Urinvolumen reduziert wird.

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