Sodium appetite elicited by aldosterone¹

George Wolf
YALE UNIVERSITY

Abstract

Rats given access to .25 M saline in addition to drinking water were injected with either 0.5 or 1.0 mg doses of d-aldosterone acetate. Consistent increases in saline intake were observed in two of three rats injected with the 0.5 mg dose and in all six rats injected with the 1.0 mg dose.

Problem

Sodium appetite can be elicited in rats without sodium deficiency by treating them with desoxycorticosterone, an intermediary product of the adrenal cortex (Rice & Richter, 1943; Wolf, 1964). This finding suggests that the adrenal cortex may play a role in the regulation of sodium appetite as well as in other aspects of body sodium regulation. The purpose of the present study was to determine whether sodium appetite can similarly be elicited by the natural salt-regulating corticoid of the rat—aldosterone.

Method

Six male Holtzman Sprague-Dawley rats between 300 and 400 gms in body weight were used. They were housed in individual cages and given Purina chow, distilled water and .25 M saline ad lib. Water and saline were given in inverted graduated test tubes with standard drinking nozzles which protruded through the fronts of the cages about 4.0 cm apart and 4.0 cm above the floor. Fluid ingestion was measured daily. Each day the containers were refilled and the positions of the two solutions were reversed.

After six days of adaptation to the above conditions, during which time saline intake generally declined to less than 1.0 ml per day, three of the rats (Group A) were given daily sub-cutaneous injections of 0.5 mg d-aldosterone acetate in .25 ml sesame oil and the other three (Group B) were injected with .25 ml of only the vehicle. The injections were given for six days. While two of the rats in Group A showed an increase in saline intake, one showed none. Therefore, the three rats of Group A were given 1.0 mg doses for an additional two days. The three group B rats received no injections during these two days but were injected with 1.0 mg of aldosterone daily for the following two days.

Results

Figure 1 shows mean daily saline intake for the two groups of rats. The pre-injection scores are the means of the last two days of the adaptation period. (One rat of Group B ingested 10 ml of saline on one of these two days but then avoided the saline as did the other rats,

Fig. 1. Mean daily saline intake, averaged in two day blocks, for the two groups. Pre-injection scores are mean of last two days of adaptation period. Brackets show the standard errors of the means of each point.

until treatment with aldosterone—therefore this amount was not included in the rat's mean pre-injection score.) The 0.5 mg dose produced large and consistent increases in saline intake in two of the three rats of Group A, but the mean intake of the group did not increase significantly because of the failure of one rat to respond. The 1.0 mg dose of aldosterone produced large increases in all rats of both groups and the increase was highly significant ($p < .001$ in comparison to pre-injection intake by "t" test). Saline preference (ratio of saline intake to total fluid intake) also increased significantly after treatment with 1.0 mg of aldosterone ($p < .001$).

Discussion and Summary

The results show that sodium appetite can be elicited in normal rats by treatment with aldosterone, the natural mineralocorticoid. The fact that unphysiological doses were necessary to elicit increased sodium intake under the present conditions does not preclude the possibility that endogenous mineralocorticoids may potentiate sodium appetite in an animal with a sodium deficiency—a condition which by itself can be sufficient to elicit sodium appetite (Richter, 1936) and which would provide the proper “conditioning” factors for the appetitive action of the mineralocorticoids. The necessity for using high doses to induce voluntary sodium intake in the absence of need (i. e., in a physiologically unreceptive animal) is understandable. In addition it is very probable that under the present conditions the mineralocorticoid may inhibit the excretion of ingested sodium and thus elevate body sodium levels. Presumably a high level of circulating mineralocorticoid would be necessary to overcome the demonstrated tendency of a sodium overload to inhibit the intake of sodium (Beilharz & Kay, 1963; Stellar et al, 1954).

Comment

Kimmel apparently failed to realize that the conclusion he questioned rested on more than just a significant interaction. It was specifically stated in the article (*Psychon. Sci.*, 1964, 1, 139-140) that the extinction curve for No-Shock-No Shock started above and ended below the extinction curve for Shock-No Shock. Inspection of the curves, together with the given F for interaction, should have made it clear that this cross-over effect was real. To remove any remaining doubt, the interaction was recomputed omitting the first trial block of extinction. The F for interaction, quadratic was 6.31, $df = 1/14$, $p < .025$. Since the two groups were nearly equal on the second trial block of extinction, this shows that the Shock-No Shock group was more resistant to extinction.

References

- BEILHARZ, S., & KAY, R. N. B. The effects of ruminal and plasma sodium on the sodium appetite of sheep. *J. Physiol.*, 1963, 165, 468-483.
- RICE, K. K., & RICHTER, C. P. Increased sodium chloride and water intake of normal rats treated with desoxycorticosterone acetate. *Endocrinology*, 1943, 33, 106-115.
- RICHTER, C. P. Increased salt appetite in adrenalectomized rats. *Amer. J. Physiol.*, 1936, 115, 155-61.
- STELLAR, E., HYMAN, R., & SAMET, S. Gastric factors controlling water- and salt-solution-drinking. *J. comp. physiol. Psychol.*, 1954, 47, 220-26.
- WOLF, G. Sodium appetite elicited by desoxycorticosterone. Unpublished doctoral dissertation, Yale Univer., 1964.

Note

1. Work in this study was supported by grant MH02949 from the National Institute of Mental Health, United States Public Health Service. The author is thankful to Dr. Robert Gaunt, Ciba Pharmaceutical Co., for supplying the aldosterone.

Kimmel's remaining comments, which concern minor aspects of the statistical analysis, do not seem well taken. There was obviously good a priori reason to test for the linear component of shock. The shock levels were chosen on the basis of previous results to be about equally spaced in their effect on behavior. The power of the experiment is increased to the extent that this choice is successful. (Of course, the use of the specific comparison represented by the linear component does not require equal spacing of the independent variable.) Extraction of the linear and quadratic trends of the interaction would be expected to increase the power of that test but was unnecessary since the overall interaction F was highly significant.

Eileen B. Karsh
Drexel Institute of Technology