11501

Salt After Adrenalectomy. II. Urinary Excretion of Radioactive Na and K in Adrenalectomized Rats Given Various Levels of Salt.*

EVELYN ANDERSON, MICHAEL JOSEPH AND VIRGIL HERRING.
(Introduced by Herbert M. Evans.)

From the Institute of Experimental Biology and the Department of Medicine of the University of California, Berkeley and San Francisco, California.

In an earlier communication[1] we reported the use of radioactive sodium and potassium in the detection of changes in the urinary excretion rate of sodium and potassium after adrenalectomy. It was found that adrenalectomized rats fed one of our stock diets which contained 1.75% NaCl, and given tap water to drink showed an increased rate of excretion of administered radioactive sodium and a diminished rate of excretion of radioactive potassium. The rate of excretion of these tagged electrolytes could be correlated with the excretion of body sodium and potassium. We also showed that the giving of a one percent sodium chloride solution to adrenalectomized rats instead of tap water corrected the wastage of sodium and the retention of potassium, so that these animals excreted these electrolytes in the same proportions as normal animals.

In the preceding communication[2] the growth and survival of adrenalectomized rats given 1% NaCl solution has been described. Out of a group of 25 adrenalectomized rats which were given 1% NaCl to drink and which were fed a diet which contained 1.75% NaCl, 10 lived beyond the 110th day after operation. The capacity of these animals to excrete given amounts of radioactive sodium and potassium was measured from time to time.

The methods used and the standardization of the conditions necessary for this study have been described previously.[1] The data of this study are given in Table I. It will be seen that adrenalectomized rats on 1% NaCl (with a total NaCl intake of 725 mg daily) at first excrete the administered radioactive sodium like the control animals but later show sodium retention. This discrepancy

* We wish to acknowledge the assistance of the Federal Works Progress Administration, Project No. OP 65-1-08-62, Unit A-5, and the Christine Breon Fund. We wish to thank Dr. John H. Lawrence, of the Radiation Laboratory of this University, for supplying us with the radioactive sodium and potassium.

1 Anderson, E., and Joseph M., PROC. SOC. EXP. BIOL. AND MED., 1939, **40**, 347.

2 Anderson, E., Joseph, M., and Herring, V., PROC. SOC. EXP. BIOL. AND MED., 1940, **44**, 477.

TABLE I.
Urinary Excretion of Na and K in Adrenalectomized Rats Given 1% NaCl.

Days post-adrenalectomy	Na^{24} 13th	Na^{24} 26th	Na^{24} 80th	Na^{24} 126th	Total Na 80th	K^{42} 5th	K^{42} 16th	K^{42} 48th	K^{42} 90th	K^{42} 136th	Total K 90th
Group I											
Normal rats on 1% NaCl	36.7(5)* (33.0-40.0)†	35.0(10) (30.8-42.1)	31.9(3) (26.8-35.8)	31.9(3) (26.8-35.8)	81(3) (77-87)	10(5) (8.8-11.6)	9.7(5) (8.4-10.4)	9.0(10) (8.2-10.4)	11.9(3) (10.2-12.8)	11.9(3) (10.2-12.8)	43(3) (40-48)
Group II											
Adrenalectomized rats on 1% NaCl	35.7(5) (33.0-37.5)	32.3(6) (28.6-40.0)	24.6(2) (23.9-25.2)	17.8(5) (15.1-21.5)	70(2) (63-68)	9.6(5) (7.8-10.0)	9.0(5) (8.4-10.0)	10.8(6) (8.2-12.1)	12.3(5) (9.3-15.5)	12.6(5) (10.1-14.3)	46(5) (37-52)

*Number of animals in parentheses.
†Range of values.

increases as the period after adrenalectomy increases. This is in marked contrast to the behavior of untreated adrenalectomized animals, in which there is an increased excretion of sodium. The excretion of radioactive potassium in the adrenalectomized animals of this group was essentially the same as that of the control animals; as stated above the untreated adrenalectomized animal excretes a diminished amount of potassium. It can be noted that the excretion of body sodium and potassium bears a definite correlation to the excretion of radioactive sodium and potassium.

Increasing the amount of NaCl administered to adrenalectomized rats beyond an optimal level, proved to be injurious as described in the preceding communication.[2] However, these high doses of NaCl enabled the adrenalectomized rat to continue to excrete radioactive sodium and potassium like normal controls. These data are given in Table II. The animals in Group I of Table II received

TABLE II.
Urinary Excretion of Na and K in Adrenalectomized Rats on High NaCl Intake.

	Sodium		Potassium K^{42}		
Days post-adrenalectomy	Na^{24} 20th %	Total Na 20th mg	12th %	24th %	Total K 24th mg
Group I (4 cc 5% NaCl 2x daily = 400 mg					
Adrenalectomized rats	36.2(5)* (33.0-40.0)†	—	8.6(5) (7.8-8.8)	9.2(5) (8.4-10.4)	—
Normal rats	35.0(10) (30.8-42.1)	—	9.7(5) (8.4-11.5)	—	—
Group II (4 cc 5% NaCl 4x daily = 800 mg)					
Adrenalectomized rats	31.6(5) (27.2-37.5)	89(5) (85-94)	8.9(5) (8.8-10.0)	10.0(3) (9.5-10.4)	39(3) (36-43)
Normal rats	36.0(3) (33.0-37.5)	83(3) (79-88)	7.7(3) (6.4-8.8)	9.4(3) (9.1-9.5)	40(3) (36-43)

*Animals per group in parentheses.
†Range of values.

400 mg NaCl administered in a 5% NaCl solution, in addition to about 245 mg of NaCl in the food. As described previously,[2] these animals continued to grow and remained in a healthy condition. Those of Group II received 800 mg of NaCl in addition to approximately 245 mg of NaCl in the food. The adrenalectomized animals of this group were all dead by the 28th post-operative day. However, in both groups of adrenalectomized rats the excretion of electrolytes resembled that of normal rats. The total sodium and potassium excreted showed a definite correlation with the percent of radioactive sodium and potassium excreted.

Summary. The administration of sodium chloride to adult adrenalectomized rats in amounts varying from 650 mg to 1 g daily prevents the urinary sodium wastage and potassium retention which characterizes adrenalectomized animals.

11502 P

Oxidation of Tyrosine by Ultraviolet Light in its Relation to Human Pigmentation.

STEPHEN ROTHMAN. (Introduced by G. F. Dick.)

From the Department of Medicine, Section of Dermatology, and the Department of Pharmacology, University of Chicago.

In the skin of mammals tyrosinase never has been conclusively demonstrated. It has been assumed[1] that the immediate precursor of melanin in mammalian skin is 3-4 dihydroxy-phenylalanin ("dopa") which becomes oxidized to melanin by an intracellular specific oxidase present only in normal functioning melanoblasts. The question has remained unsettled from where this dopa may originate; whether it is formed from tyrosine in the blood[2] or in the skin.

Arnow[3] demonstrated the formation of dopa by exposure of tyrosine solutions to ultraviolet radiation. As shown in our laboratory, this process needs a strikingly long irradiation time, namely 8-30 times as much as necessary for slightest pigmentation of human skin. In the presence of ferrous salts, however, the formation of dopa from tyrosine by ultraviolet irradiation is accelerated to such a degree that it may serve as a model of the biologic formation of dopa in human skin.

Samples containing mixtures of tyrosine and ferrous salts, irradiated with 1-3 "threshold erythema doses" yield measurable amounts of dopa but no melanin. When such irradiated samples are kept in the dark, progressively increasing amounts of precipitated melanin are formed after 16-24 hours. In this way the latent period of pigment formation in human skin is simulated by the *in vitro* experiments.

The late formation of melanin occurs for the greatest part at the

1 Bloch, Br., *Jadassohn's Handb. d. Haut. u. Geschlkr.*, 1927, **1**, 434.

2 Rothman, S., *Z. f. d. ges. exp. Med.*, 1923, **36**, 398.

3 Arnow, L. E., *J. Biol. Chem.*, 1937, **120**, 151.