Influence of the Kidney on Electrolytes of the Aorta.* (26229)

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Previous investigations from this laboratory have demonstrated a positive correlation between potassium concentrations of arterial tissue and blood pressure levels(1). The increased aorta potassium content in renal hypertensive rats, first shown by Tobian and Binion(2), was considered to be a specific response to the ischemic kidney.

In the following experiment, an attempt was made to clarify the influence of the kidney on potassium content of the aorta in relationship to blood pressure. The effects of nephrectomy and ureteral tie on electrolytes of the aorta and blood pressure in hypertensive rats were studied for this purpose.

Methods. Six-weeks-old male Long-Evans rats were subjected to a modification of Grollman's method for inducing renal hypertension(3), *i.e.*, uninephrectomy and a figure-of-eight ligature around the remaining kidney. In a group of rats which exhibited significant hypertension 6 to 8 weeks later, the ligatured kidney was excised. After approximately 3 hours, blood pressures were obtained(4) and the animals then sacrificed. Blood, heart, skeletal muscle and aorta were removed for analyses of sodium and potassium as previously described(5).

A second group of hypertensive rats were subjected to ureteral ligation of the ischemic kidney. Three hours later, blood pressures were determined and the animals sacrificed for similar analyses.

A number of control groups were also studied, consisting of normal rats with bilateral nephrectomy, bilateral ureteral ligature, and sham operated by renal manipulation only. Two groups of rats subjected to the figure-of-eight renal ligation but which remained "normotensive" were also included. One group was nephrectomized and the other had a ureteral ligation performed. These rats as well as the normal controls were examined for blood pressure changes 3 hours after operative procedure, then sacrificed for analysis of electrolytes of similar tissues.

Results. In Table I are presented results obtained from the intact rats. In rats of all groups, nephrectomy, ureteral ligation and renal manipulation, there was a small decline in blood pressure. There was also a slight decrease in sodium and potassium content of the aorta in nephrectomized and ureteral ligated rats as well as a slight decrease in myocardial potassium. Sodium content of the skeletal muscle of the operated rats was significantly increased.

Table II shows the results in hypertensive and "normotensive" rats. Nephrectomy induced a marked fall in blood pressure of hypertensive rats (70 mm Hg) and only an insignificant decrease (12 mm Hg) in hypertensives with ureteral ligation. There was relatively little change in blood pressure level of "normotensive" rats subjected to these operative procedures.

There was a marked fall in blood pressure to normal levels in the hypertensive rats following nephrectomy, associated with a decrease in aorta potassium content to normal from the originally elevated values. Aorta potassium content and blood pressure remained at elevated levels in hypertensive rats subjected to ureteral ligation. There was little change in aorta sodium content of either group.

In the "normotensive renal" ligated rats the elevated aorta potassium content fell to normal values following either nephrectomy or ureteral ligation. There was also a decrease in aorta sodium content in these animals similar to that observed in the intact rats.

Electrolytes of the myocardium remained unchanged after nephrectomy or ureteral ligation in both hypertensive and renal ligated "normotensive" animals. Skeletal muscle showed an increase in sodium content, as in the intact rats of Table I, but there was also an increase in potassium content in the hy-

* Aided by a grant from N.I.H.

TABLE I. Nephrectomy and Ureteral Ligation on Electrolytes and Blood Pressure of Normal Rats.

Type of rat	No.	Avg original B.P., mm Hg	Aorta*		Myocardium*		Skeletal muscle*		Serum		Avg post-op. B.P., mm Hg	Change in B.P., mm Hg
			Na	K	Na	K	Na	K	Na	K		
			meq/kg						meq/l			
Normal	12	116 (104–124)	273 ± 5.1†	111 ± 2.0	172 ± 4.8	317 ± 2.8	105 ± 3.8	394 ± 3.6	146 ± 3.1	5.2 ± .18		
Normal (sham operation)	8	112 (102–122)	254 ± 5.8	110 ± 1.8	170 ± 6.0	314 ± 3.1	100 ± 5.1	379 ± 4.0	143 ± 2.9	5.9 ± .27	104 (94–116)	−8
Normal, nephrectomy	10	112 (106–118)	236 ± 6.7	100 ± 3.1	168 ± 5.4	289 ± 2.6	126 ± 4.3	385 ± 3.6	144 ± 3.4	5.9 ±1.1	100 (90–110)	−12
Normal, ureteral tie	9	108 (102–122)	238 ± 7.2	104 ± 2.6	167 ± 6.9	294 ± 3.1	128 ± 5.0	392 ± 4.8	143 ± 3.2	6.1 ±1.4	102 (86–112)	−6

* Fat-free dry wt.

† ± stand. dev.

TABLE II. Nephrectomy and Ureteral Ligation on Electrolytes and Blood Pressures of Renal Ligated Rats.

Type of rat	No.	Avg original B.P., mm Hg	Aorta*		Myocardium*		Skeletal muscle*		Serum		Avg post-op. B.P., mm Hg	Change in B.P., mm Hg
			Na	K	Na	K	Na	K	Na	K		
			meq/kg						meq/l			
Fig. 8, hypertensive	14	186 (160–212)	280 ± 7.3†	131 ± 3.6	161 ± 4.9	294 ± 4.2	100 ± 3.1	379 ± 2.6	141 ± 1.4	5.2 ±.20		
Fig. 8, hypertensive, nephrectomy	14	192 (156–220)	266 ± 6.3	110 ± 2.2	167 ± 5.1	298 ± 2.6	127 ± 2.0	408 ± 4.9	143 ± 1.8	6.6 ±.30	122 (104–130)	−70
Fig. 8, hypertensive, ureteral tie	12	184 (158–210)	270 ± 8.4	126 ± 3.1	177 ± 4.2	296 ± 2.9	124 ± 3.0	413 ± 3.8	142 ± 1.1	6.5 ±.41	172 (140–192)	−12
Fig. 8, normotensive	11	128 (110–134)	260 ± 6.7	122 ± 2.9	167 ± 5.6	295 ± 3.8	107 ± 3.3	376 ± 2.1	139 ± 2.4	5.3 ±.22		
Fig. 8, normotensive, nephrectomy	12	126 (108–132)	241 ± 7.1	108 ± 1.9	172 ± 4.9	297 ± 4.0	125 ± 3.4	406 ± 4.1	142 ± 1.3	6.3 ±.41	116 (94–124)	−10
Fig. 8, normotensive, ureteral tie	8	122 (110–128)	240 ± 6.9	109 ± 2.1	170 ± 5.9	288 ± 3.6	120 ± 3.0	386 ± 5.4	148 ± 3.4	6.4 ±.32	124 (102–142)	+2

* Fat-free dry wt.

† ± stand. dev.

pertensive rats subjected to either nephrectomy or ureteral ligation.

Discussion. There are a number of changes in electrolyte content of the various tissues of the experimental rats. It is apparent that most of them are probably the result of urinary retention since they were induced either by nephrectomy or ureteral ligation. For the purpose of this presentation, there seems little need to discuss them in detail.

There is a distinct difference between the effect of nephrectomy and ureteral ligation on aorta potassium content of the hypertensive rats. Following removal of the ischemic kidney, potassium content of the aorta falls promptly to normal values along with the marked decline in blood pressure. Hypertensive rats with the ureteral ligature show neither a change in aorta potassium content nor blood pressure. The effect of nephrectomy on loss of potassium from the aorta appears to be a specific response since in the same animal there is an increase in skeletal muscle potassium content.

It would appear therefore that removal of the ischemic kidney eliminates a substance elaborated by this organ which induces an elevation in aorta potassium content in association with hypertension. It remains to be demonstrated whether or not this is a pressor substance. These results add to the evidence that potassium content of arterial tissues has a positive correlation with blood pressure levels. As has been previously discussed, this cation may influence blood pressure level through altering arterial tone(1).

The evidence pertaining to the role of potassium in regulation of blood pressure is quite scanty in comparison to that of sodium. The relationship of arterial tissue electrolytes to blood pressure was recently reviewed extensively by Tobian(6), who stated "the level of potassium correlates somewhat better with blood pressure than the level of sodium."

Summary. Removal of the ischemic kidney of hypertensive rats but not ureteral ligation, induces a marked fall in blood pressure and a significant decrease in aorta potassium content. It is suggested that the ischemic kidney elaborates a substance which induces hypertension and also increases potassium content of arterial tissue.

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Received September 22, 1960. P.S.E.B.M., 1961, v106.

Differences in Thyroid Function of Several Strains of Mice.*† (26230)

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The reaction of the thyroid to an antithyroid drug differs in intensity in different strains of the same animal species. Thiouracil administration increases thyroid weight in some strains of mice more than in others (1,2). Wilson(3), using increase of thyroid epithelium and depletion of colloid as criteria, found considerable differences in degree of histological reaction between different strains of mice after feeding a semisynthetic diet with 0.5% sulfadiazine. The strongest reaction was found in the C_3H/Wi and BUB/Wi mice, a less strong reaction in

* A portion of a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Brown University, June 1959.

† This investigation was aided by a University Fellowship 1956-57 and 1957-58, and by a Universal Match Foundation Fellowship 1958-59. It was supported by a research grant from Nat. Cancer Inst.