the total number of capsomeres can be determined with the formula $10(n-1)^2+2$, where n is the number of capsomeres present along one edge of a triangular face.

There are structural similarities regarding the shape, number of faces and number of capsomeres among the adenovirus, infectious canine hepatitis virus and CELO virus. All 3 viruses have cubic symmetry, are icosahedron and have 252 capsomeres in each virus particle. The diameter of the adenovirus is 70 mμ, infectious canine hepatitis is 82 mμ and CELO virus is 73 mμ. Further, Petek *et al* (6) reported the similarities in physio-chemical and biological properties of the adenovirus and CELO virus. Because of the similarities in morphological, physio-chemical and biological properties of adenovirus and CELO virus, it seems justified to classify the CELO virus in the adenovirus group.

Summary. The chicken embryo lethal orphan (CELO) virus is 73 mμ in diameter and the distance between the centers of adjacent capsomeres is 76 Å. The virus is a regular icosahedron (cubic symmetry) having 252 capsomeres and without an envelope. The CELO virus could be classified in the adenovirus group.

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Effect of Sodium on Juxtaglomerular Index and Zona Glomerulosa in Experimental Nephrosis.* (28727)

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It has been established that the degree of granulation of renal juxtaglomerular cells (JGI) may be affected by the sodium state of the animal. Reduction in dietary sodium or adrenalectomy results in hypergranulation whereas the converse is obtained by salt overload and some situations characterized by sodium retention. These effects have been equated with accompanying alterations of blood volume and the juxtaglomerular apparatus has been visualized as a stretch receptor (1). Recent studies in our laboratory, although not subverting this latter concept, have indicated the significance of electrolyte composition in accounting for the decreased JGI consistently observed in untouched kidneys of rats with renal hypertension induced by the application of a constricting clip about the renal artery of the contralateral member (2). Investigation of the effect of sodium depletion and salt overload on the nephrotic syndrome, which is characterized by sodium retention and decreased blood volume, would also appear to represent a suitable experimental model in which to delineate electrolyte and pressor or hemodynamic factors which may be responsible for alterations in JGI. Tobian *et al*(3) noted statistically significant greater JGI in ascitic than non-ascitic rats with the nephrotic syndrome induced by administration of aminonucleoside, although comparison with the normal was not made. Since JGI represents a reliable index of renin activity and aldosterone secretion may be reflected by the appearance of the zona glomerulosa of adrenal cortex, studies of these parameters should provide pertinent infor-

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mation concerning the role of the renin-angiotensin-aldosterone mechanism in the pathogenesis of certain features of the nephrotic syndrome.

Methods. Seventy-two adult female Wistar rats weighing 150-200 g survived the experiment. The following groups were comprised of 12 animals each. Group A received 9 consecutive, daily, subcutaneous injections of 0.003 ml per g of 0.5% aqueous aminonucleoside (AN). Those of Groups B and C received a similar course of AN except that the former were subjected to sodium depletion by peritoneal dialysis one day prior to AN administration and the latter salt overload with 1% saline as drinking fluid. Rats of Group D were depleted of sodium by dialysis and those of Group E subjected to salt overload only. Untreated controls comprised Group F.

Peritoneal dialysis was performed by withdrawal of 12 ml of peritoneal fluid 3 hours after instillation of 25 ml of 5% glucose in water. Dialyzed rats were maintained on a sodium deficient diet (General Biochemicals Co., Chagrin Falls, Ohio) and de-ionized water as drinking fluid. All other animals received the same diet containing 1% NaCl and tap water, except those in Groups C and E in which 1% saline drinking fluid was used.

All rats were housed in individual metabolism cages and daily urinary protein estimated as described previously(4). Blood pressure was determined by a microphonic method prior to and at the conclusion of experiment. Ascites was estimated at time of sacrifice by emptying peritoneal fluid into a measuring cylinder. Rats receiving AN were sacrificed by aortic puncture 3 days after the last injection and those of other groups 12 days after the start of the experiment.

Serum Na, Cl, BUN, cholesterol, total lipid and total protein were determined as described previously(4). Small cubes of kidney were quickly fixed in 1% buffered osmium tetroxide, dehydrated and embedded in Vestopal W for electron microscopy. Other portions of kidney were fixed in Helly's fluid and sections stained for estimation of JGI

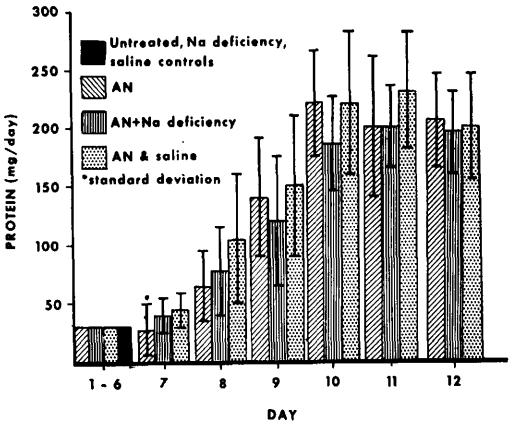

FIG. 1. Effects of Na deficiency and saline overload on urinary protein of untreated and AN-treated rats.

according to the method of the Hartrofts (5). Adrenals were blotted and weighed. Frozen sections were stained with oil red O after fixation in 10% formalin. The width of the zona glomerulosa was expressed as percentage of cortex (ZGI).

Results. No difference in time of onset of proteinuria (6-7 days), daily urinary protein (Fig. 1) hyperlipidemia, nitrogen retention, or hypoproteinemia was evident in AN-treated rats subjected to sodium depletion (Group B), salt overload (Group C) or those in which sodium intake was unaltered (Group A (Table I). Blood pressure was comparable in all AN-treated groups, being significantly lower than that encountered in controls ($P<.01$) (Table II). The ultrastructural appearance of kidneys was also similar in AN-treated rats of all groups to that described previously in this experimental disorder, consisting principally of swelling and vacuolation of glomerular epithelium and loss of epithelial foot processes.

Sodium deficient, AN-treated rats (Group B) failed to exhibit ascites or anasarca. These parameters were accentuated in AN-treated rats with sodium overload (Group C) (Table I) in which measurable ascites was 51 $\pm$ 28 ml compared to 7 $\pm$ 4 ml of AN-treated controls (Group A).

JGI of AN-treated rats of Group A was significantly greater than that of normal controls receiving a comparable diet and fluid intake ($P<.01$) (Table II). No difference

TABLE I. Effect of Na Intake on Biochemical Alterations and Ascites of AN Nephrosis.

	#	BUN* (mg %)	Cholesterol (mg %)	Total lipid (mg %)	Total protein (g %)	Na (meq/l)	Cl† (meq/l)	Ascites (ml)
A. AN	12	62 ± 9‡	391 ± 38	673 ± 50	4.8 ± .4	146 ± 4	119	7 ± 4
B. AN–Na deficient	12	78 ±16	428 ± 42	720 ± 57	5.0 ± .2	145 ± 6	110	0
C. AN–1% saline	12	78 ±14	456 ± 18	760 ± 28	5.2 ± .4	158 ± 6	124	51 ±28
D. Na deficient	12	22 ± 5	95 ± 18	140 ± 22	6.0 ± .4	142 ± 6	105	0
E. 1% saline	12	27 ± 8	118 ± 21	165 ± 30	5.9 ± .2	169 ± 5	118	0
F. Normal	12	25 ± 5	95 ± 15	132 ± 24	6.1 ± .3	144 ± 4	104	0

* Samples pooled in groups of 4. † Samples pooled for one group. ‡ Standard deviation.

TABLE II. Effect of Na Intake on Adrenal Weight, JGI, ZGI and Blood Pressure in AN Nephrosis.

	JGI	ZGI	Adrenal wt (mg)	Blood pressure (mm Hg)
A. AN	34 ± 7*	12 ± 5	60 ± 10	70 ± 15
B. AN–Na deficient	49 ± 10	20 ± 3	65 ± 9	75 ± 12
C. AN–1% saline	24 ± 13	6 ± 2	60 ± 16	65 ± 8
D. Na deficient	40 ± 15	18 ± 3	62 ± 13	93 ± 6
E. 1% saline	25 ± 12	8 ± 1	65 ± 12	94 ± 8
F. Normal	25 ± 8	7 ± 2	58 ± 11	98 ± 9

* Standard deviation.

from normal in JGI was evident in AN-treated and untreated rats subjected to salt overload (Groups C & E). JGI was significantly greater in sodium depleted, AN-treated rats (Group B) than in rats of other groups receiving AN and statistically comparable to those of untreated deficient animals (Group D).

Variation in width of the zona glomerulosa of adrenal cortices paralleled the findings in JGI in all groups, although no statistical difference in adrenal weights from normal was noted in any experimental group (Table II).

Discussion. Results obtained indicate that sodium depletion or salt overload fail significantly to influence proteinuria, biochemical and morphological alterations of AN nephrosis. However, absence of ascites in sodium depleted, AN-treated rats and its accentuation in those subjected to salt overload emphasize the significance of sodium in development of nephrotic edema. Unlike the findings of Tobian *et al*(3) we could discern no direct relationship between degree of ascites and JGI among individual members of the various experimental groups, although variations in the former were relatively small. The absence of ascites in sodium depleted, AN-treated rats which exhibited a significantly greater JGI than AN controls and the converse in those subjected to salt overload and AN indicates that ascites *per se* is not responsible for the elevated JGI noted in the AN-treated controls. The absolute mechanism accounting for alterations in JGI observed in AN-treated rats receiving a normal complement of sodium might be the result of decreased blood volume attendant with the nephrotic state or activity of the juxtaglomerular cells directed toward conservation of normal osmolarity of blood, altered by the proteinuria experienced by these animals. Increased JGI encountered in sodium depleted, AN-treated rats might also be considered as the result of a greater demand for sodium retention or the result of a more profound decrease in blood volume. The normal JGI observed in AN-treated rats subjected to salt overload might also be explained as either the result of a redistribution of extracellular fluid within the vascular compartment with reestablishment of a more normal blood volume or alternatively as the result of a relative lack of demand for this mechanism to conserve sodium because of its increased exogenous source. The relatively short period of these experiments appears to account for

the failure to note significant alteration of JGI from normal in controls receiving excessive salt intake. However, the significantly lower JGI in AN-treated rats receiving 1% saline as drinking fluid than in AN controls indicates that the juxtaglomerular apparatus of nephrotic rats may be more sensitive to changes in electrolyte composition or blood volume than that of untreated controls. These interpretations are consonant with the view that juxtaglomerular cells may represent stretch receptors(1). However, they also signify their importance, as was apparent in a previous study of JGI in renal hypertension (2), as osmoreceptors, particularly in regard to electrolyte composition. The absence of significant differences in blood pressure in the various groups of AN-treated rats tends to minimize pressor or hemodynamic influence on changes in JGI encountered.

Although there was no significant difference in adrenal weight of rats of the various groups, statistically significant variations in width of zona glomerulosa, which paralleled those of JGI, were encountered. These changes in JGI and ZGI are considered to represent morphological evidence of the existence of the renin-angiotensin-aldosterone mechanism (6) in AN nephrosis and support the contention relating a secondary role to adrenal cortical function in the pathogenesis of ascites in the nephrotic syndrome(2).

Although excess salt feeding for 2 to 6 months has been noted to induce hypercholesterolemia in otherwise untreated rats(7) no effect on the hyperlipidemia of nephrosis was noted in AN-treated rats subjected to alteration of sodium intake. Whether this lack of effect is the result of the difference in duration of the experiments or other cause remains to be demonstrated.

Summary. Sodium deficiency and salt overload failed to influence degree of proteinuria and biochemical and ultrastructural features of AN nephrosis. Ascites was absent in AN-treated, sodium deficient rats which exhibited elevated JGI and increased width of zona glomerulosa (ZGI) of adrenal cortex; whereas AN-treated rats subjected to salt overload had massive ascites but normal JGI and ZGI. This information indicates that the elevated JGI and ZGI observed in AN-treated rats maintained with a normal sodium-containing diet are not due to ascites *per se*. Although the changes encountered in this study in JGI may be due to alteration in blood volume, emphasis is also directed to the causal effects of electrolyte alterations and blood osmolarity. Parallel changes of JGI and ZGI are interpreted as evidence of activity of the renin-angiotensin-aldosterone mechanism in AN nephrosis and the secondary role of aldosterone in ascites production in this syndrome.

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