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Aldosterone Excretion from Infancy to Adult Life

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A method is described for collecting and processing urine from infants for analysis of its content of steroids. Recovery experiments indicate an accuracy of 70 to 90 per cent. A range of normal values for urinary excretion of aldosterone by infants, children and young adults is recorded.

SINCE CLINICAL STATES involving increased production of aldosterone occur in children, an index of aldosterone production is necessary for proper diagnosis in some conditions. Although the level of urinary aldosterone is not an infallible index of secretion of aldosterone, it is nevertheless a good one.

This communication presents normal values for excretion of aldosterone obtained from the urine of 40 healthy subjects ranging in age from 4 months to 20 years. Twenty-five subjects were 10 years old or less and 15 ranged from 11 to 20 years of age. The results obtained on 13 additional subjects over the age of 21 are compared with those in the younger age groups. All subjects were consuming average amounts of dietary electrolytes.

In addition, a simple and reasonably accurate 'diaper method' for collection and processing of urine for steroidal content is described.

SUBJECTS AND METHODS

Table 1 gives the age and sex distribution of the 40 normal infants, children, and young adults that were studied. The table includes the additional group of normal people above the age of 20 who were similarly studied. On 16 of the normal children, two 24-hour collections of urine were made and the aldosterone value for each was determined. Most of the subjects were the children of our own laboratory staff. Throughout this study, a modification of the method of Neher and Wettstein[1] was employed.

THE COLLECTION OF URINE FROM INFANTS

The method for collection of urine from infants employed the use of highly absorbent cotton diapers. These were prewashed with 0.1N HCl, 0.1N NaOH,

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Table 1.—*Values for Aldosterone Excretion on 53 Subjects*

No.	Subject	Age		Sex	Body Weight Kg.	Aldo. μg./24 hr.
		yr.	mo.			
1.	C. S.*	–	4	F	5.9	1
		–	5		6.4	1
2.	L. P.*	–	5	F	7.2	2
		–	6		7.7	3
3.	P. J. P.*	–	7	M	8.2	2
4.	D. M.*	–	9	F	10.0	2
		–	10		10.4	4
5.	B. B.*	–	11	M	10.9	2
		1	0		11.8	2
6.	E. A.*	1	0	F	10.0	2
		1	1		10.9	5
7.	K. M. H.*	1	6	M	12.7	5
8.	B. A. M.	2	1	F	14.5	3
9.	R. L. F.	2	7	M	14.5	3
10.	B. C.	2	8	F	11.8	1
		2	9		12.2	3
11.	K. E.	2	9	M	13.6	4
12.	K. S.	2	10	F	12.2	3
		2	11		13.1	2
13.	P. S.	3	6	F	15.0	2
14.	P. C.	4	6	M	16.8	2
		4	7		17.2	4
15.	A. E.	4	11	M	27.2	8
		5	0		28.5	6
16.	J. H.	5	0	M	18.1	3
17.	H. M.	5	1	M	24.0	4
		5	2		24.5	5
18.	E. J. L.	6	7	F	20.0	7
		6	8		20.4	5
19.	E. A. L.	6	6	F	22.7	3
20.	A. T.	7	4	F	25.0	5
		7	5		25.5	4
21.	A. F.	8	0	M	26.6	4
22.	K. T.	8	6	F	28.4	6
		8	7		28.7	6
23.	J. F.	9	0	M	40.0	6
24.	A. M. R.	9	5	F	36.3	4
25.	M. A. B.	10	10	M	36.5	6
26.	M. J. B.	11	10	F	40.0	7
27.	P. F.	12	0	M	43.0	5
28.	M. M. L.	12	9	F	44.2	5
		12	10		45.0	6
29.	R. H. H.	13	7	F	57.7	9
30.	G. P. F.	13	8	M	45.4	5
31.	J. W. R.	14	1	M	68.6	6
32.	M. I.L.	14	11	F	48.1	10
		15	0		49.0	6
33.	J. L. R.	16	5	F	59.0	5
34.	R. D. F.	17	7	M	68.1	6
35.	P. H.	18	0	M	58.1	5
		18	1		59.0	6

Table 1.—*(Continued)*

No.	Subject	Age yr.	Age mo.	Sex	Body Weight Kg.	Aldo. μg./24 hr.
36.	J. A. S.	18	4	M	61.3	4
37.	K. R. S.	18	7	M	60.2	4
38.	J. D.	19	8	M	71.1	8
39.	J. B.	19	9	M	75.6	8
40.	W. S.	19	11	M	77.3	12
41.	L. D. D.	21	–	M	66.9	9
42.	C. H. S.	22	–	M	77.2	12
43.	D. M.	24	–	M	80.4	7
44.	R. R.	24	–	M	73.3	9
45.	A. A. M.	25	–	F	58.6	5
46.	B. W. O.	25	–	M	70.1	3
47.	R. L. M.	26	–	M	63.6	8
48.	D. E. M.	27	–	M	67.7	7
49.	M. C. M.	28	–	M	92.7	3
50.	G. S.	32	–	M	87.5	10
51.	S.	50	–	M	113.1	9
52.	L. H. L.	53	–	M	61.8	10
53.	E. A. H. M.	54	–	F	80.6	6

*Analyses from diapers (see text).

Table 2

dl Aldosterone			Hydrocortisone			Cortisone		
μg. Added	μg. Recovered	% Recovery	μg. Added	μg. Recovered	% Recovery	μg. Added	μg. Recovered	% Recovery
1.0	0.75	75	1.0	0.70	70	1.0	0.80	80
5.0	3.8	76	5.0	4.1	82	5.0	3.5	70
10.0	8.5	85	10.0	7.0	70	10.0	9.0	90
			20.0	15.5	77	20.0	14.0	70

Recovery of added steroids in the 'diaper collection' method.

and then with large amounts of tap water followed by a distilled water rinse. Either a porcelain or polyethylene receptacle containing 1,500 cc. of cooled distilled water was used for soiled diaper storage. Best collections of urine were obtained when a set of 4 diapers at a time was used. When a set was soiled, the firm stools were removed promptly. Fluid portions of stools remained. The set of diapers was then submerged in the iced, distilled water and kept in the dark at ± 10 C. throughout the 24-hour collection period. At the completion of the 24-hour collection, the diapers (average 20) were hand wrung (the fluid carefully saved) and then washed with 500 ml. or more of additional distilled water 3 times. The eluates were then combined. The total volume often came to 4 or 5 L. This was divided into portions of about 1,000 ml. each and then acidified with HCL to pH 1 and stored at room temperature in the dark for 24 hours. Each was then extracted with 200 ml. of reagent grade chloroform 4 times, using mechanical stirrers. The chloroform extracts were combined and then processed according to the method of Neher and Wettstein.

Occasionally as many as 48 diapers were collected in a 24-hour period. In

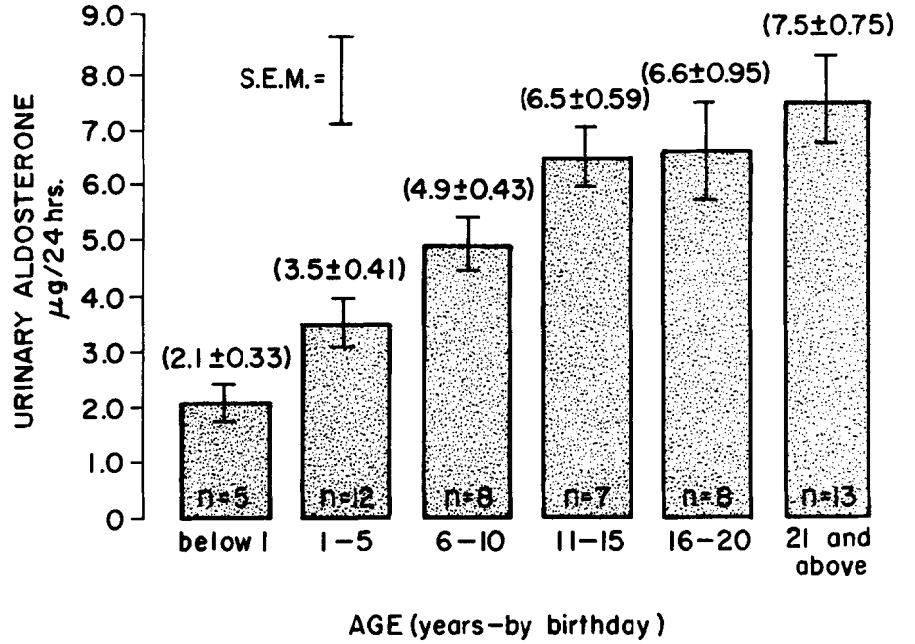

Fig. 1.—Level of aldosterone (mean) in the urine of male and female subjects from 4 months through 20 years of age.

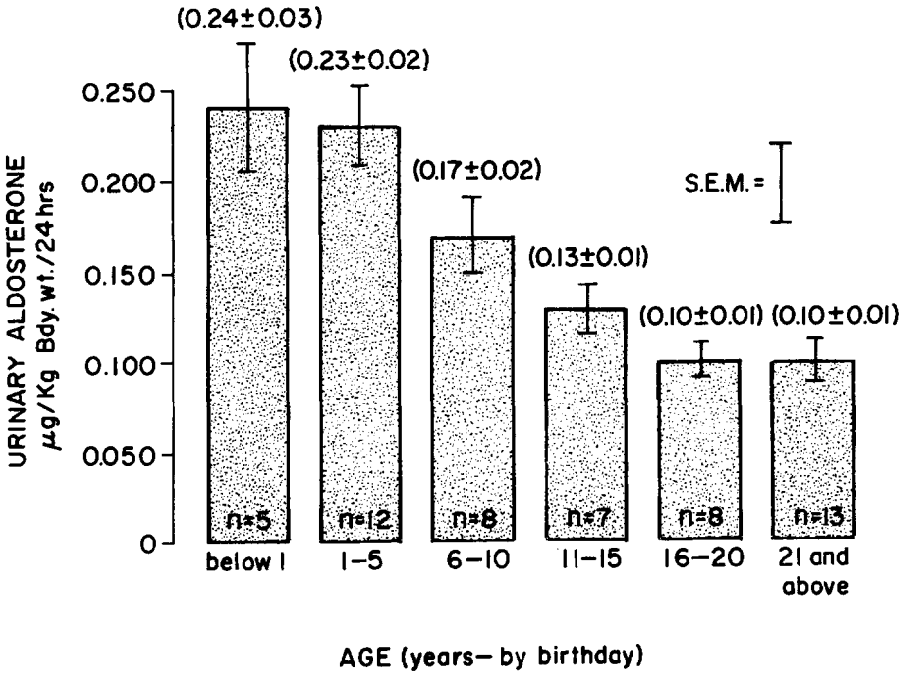

Fig. 2.—Micrograms of urinary aldosterone (mean)/Kg. of body weight of male and female subjects from 4 months through 20 years of age.

such instances they were distributed among 3 separate storage receptacles and each was processed separately. After chloroform evaporation of each, the residues were combined.

Recovery of Added Steroids from Clean Diapers

To determine the completeness of extraction of steroids from diapers 1, 5 and 10 μg. of dl aldosterone was added to an average full day's set of prewashed diapers. The entire procedure, including storage for 24 hours, was then carried out and aldosterone recovery was measured. Similar experiments, using 1, 5, 10 and 20 μg. of hydrocortisone and cortisone were also carried out. Recovery of the latter 2 steroids were also determined by a modification of the Neher and Wettstein procedure.

Table 2 gives an index of the reliability of the diaper extraction method. Eleven separate studies indicate an ability to recover 70 to 90 per cent of added steroids.

To test the reliability of the extraction procedure using the large volumes of chloroform described above, 3 water eluates from 3 different subjects were divided into halves. Each was then processed separately. The amount of aldosterone determined in each half sample was the same as that found in its corresponding half sample.

By the modification of the Neher-Wettstein procedure which we use, we are able to recover 85 to 95 per cent of aldosterone which is added to urine.

Results

Table 1 contains the data from which figures 1 and 2 have been derived. In the 16 instances in which 2 separate determinations for aldosterone were made, the results were averaged before the mean excretion values for the groups were computed.

A good correlation between urinary aldosterone and age exists between the ages of 4 months and 15 years ($r = +0.756$). Beyond age 15 no correlation exists between these 2 factors ($r = +0.194$). Figure 1 shows the results obtained in the various age groups.

Figure 2 shows the relationship between μg. of urinary aldosterone/Kg. of body weight and age. It is of interest that on the basis of body weight young people excrete considerably more aldosterone than do adults.

REFERENCE

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