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Sweat iodide excretion in patients with cycstic fibrosis of the pancreas

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SWEAT IODIDE EXCRETION IN PATIENTS WITH CYSTIC FIBROSIS OF THE PANCREAS

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THE PROBLEM

Kessler and Anderson first noted that children with cystic fibrosis of the pancreas were particularly susceptible to heat prostration (1). di Sant'Agnese *et al* explained this peculiarity by the discovery that children with this disease excreted high concentrations of sodium, potassium and chloride in their sweat (2). They further showed that the abnormality did not reside in renal or adrenal functions, so that in all probability the defect was in the sweat glands themselves. Since Bessman has pointed out that children with this disease have abnormally high concentrations of iodide in their saliva (3), it was thought desirable to investigate whether the sweat glands also exhibit this abnormality. It was felt, furthermore, that an isotope technique would be most desirable for this study because of its technical simplicity, and because the method could be easily extended to other tagged compounds present in only trace amounts.

MATERIALS AND METHODS

Thirteen children ranging in age from four months to eleven years and all with the diagnosis of cystic fibrosis of the pancreas were studied. The diagnostic criteria were the usual ones of high chloride concentration in the sweat and deficiency of enzymes in the duodenal aspirate. Fourteen children from eight months to nine years and all hospitalized for conditions unrelated to cystic fibrosis of the pancreas served as controls.

The technique of sweat collection has been previously described and illustrated (4). On the day of the test the child's breakfast was limited to orange juice, all further food being withheld until the completion of the test. One hour after breakfast, ten drops of Lugol's iodine solution were given by mouth if the child weighed 13 kilograms or over and correspondingly smaller doses were given for smaller weights. The purpose of the procedure was to load the thyroid with iodine so that it would not retain as much I^{131}. Two hours later, 2.2 microcuries of I^{131} were given orally for each kilogram of body weight to a maximum dosage of 30 microcuries. Two hours following the administration of I^{131}, sweat and blood were collected in the following manner. After preliminary cleansing of the abdomen and back with distilled water, four inch gauze pads were applied to the area, and were held in place with cellophane sheets and adhesive tape. Sweating was stimulated by wrapping the child in a plastic sheet, several wool

blankets, and one or two heating pads. When perspiration appeared on the face, the gauze pads were removed and placed on plastic golf tees in a capped centrifuged tube so that the sweat could be spun from the gauze. As the gauze pads were removed from the child, blood was drawn and centrifuged. The number of disintegrations per minute in one cc. of sweat and one cc. of serum were measured in a well counter using a decade scaler (instrument of Nuclear Measurements of Chicago). The amount of radioactivity due to the inorganic iodide was measured in the serum by passing it through an Abbot resin column. The ratio between the sweat I^{131} and the serum inorganic I^{131} was then calculated. The chloride concentration of the sweat was determined by the method of Schales and Schales in all cases (5).

RESULTS

Table I presents the results of the sweat tests on the fibrocystic children, and Table 2 those on the controls. It is to be noted that while there is no overlap of values of the sweat concentration of chloride between the fibrocystics and the normals, there is a slight overlap in values obtained for the iodide determinations. However, inspection of the means and standard errors of the means reveals that there is a significant difference between the controls and those with cystic fibrosis with regard to the handling by the sweat glands of both chloride and iodide.

Table I. Analysis of sweat from children with cystic fibrosis

SUBJECT	AGE	SERUM I^{131} cpm/cc *	% PBI †	IONIZED SERUM I^{131} cpm/cc *	SWEAT I^{131} cpm/cc *	SWEAT I^{131} / SERUM I^{131} ÷	SWEAT Cl meq/L
1	5 yr.	2789	2.5	2719	2149	0.79	120
2	10 mo.	2376	2.0	2328	1059	0.45	105
3	11 yr.	1381	2.0	1353	911	0.67	145
4	10 yr.	2581	2.5	2516	1426	0.52	160
5	14 mo.	3458	4.0	3320	2178	0.64	120
6	9 yr.	3096	20.6	2455	830	0.34	105
7	4 mo.	1534	1.4	1513	1264	0.84	83
8	9 yr.	4178	43.0	2381	1898	0.80	127
9	8 yr.	5831	43.0	3324	2231	0.67	121
10	13 mo.	2485	9.8	2241	1826	0.81	140
11	2 yr.	703	21.8	550	255	0.41	153
12	5 yr.	989	7.8	912	1071	1.17	140
13	2 yr.	1531	3.5	1478	800	0.54	133
					Mean	0.67	127
					Standard Error of the mean	0.06	6

* Counts per minute per cc.

† Percent protein bound iodine

Table 2. Analysis of sweat from children in the control group

SUBJECT	AGE	DIAGNOSIS	SERUM I^{131} cpm/cc *	% PBI †	IONIZED SERUM I^{131} cpm/cc *	SWEAT I^{131} cpm/cc *	SWEAT I^{131} / SERUM I^{131} +	SWEAT Cl meq/L
1	2 yr.	Pneumonia	2472	6.5	2311	839	0.36	10
2	5 yr.	Allergic bronchitis	2563	3.0	2486	439	0.17	15
3	11 mo.	Wry neck	2155	2.2	2108	110	0.05	_
4	yr.	Mentally retarded	2910	1.7	2860	330	0.12	_
5	8 mo.	Extra digit	1471	26.4	1086	156	0.14	_
6	1 yr.	Hydrocele	4794	14.1	4115	300	0.07	5
7	4 yr.	Seizures	3655	2.1	3578	939	0.26	25
8	4 yr.	Diarrhea	2937	14.7	2505	478	0.19	3
9	5 yr.	Seizures	3796	8.2	3485	318	0.09	14
10	9 yr.	Plastic repair	4439	4.3	4248	900	0.21	10
11	2 yr.	Esophageal stricture	2169	3.3	2097	278	0.13	11
12	5 yr.	Seizures	2267	0.0	2267	491	0.22	18
13	2 yr.	Plastic repair	2657	0.0	2657	540	0.20	25
14	5 yr.	Mentally retarded	2328	2.0	2281	436	0.19	22
						Mean	0.17	13
						Standard Error of the Mean	0.02	2

* Counts per minute per cc.

† Percent protein bound iodine

DISCUSSION

This study reconfirms the previously well known fact that children with cystic fibrosis of the pancreas secrete higher concentration of chloride in their sweat than do children who are normal, and it further tends to show that this abnormality is also manifested in the sweat gland's handling of iodide. It is of interest to note that Spector, Mitchell and Hamilton found that three subjects averaged 0.00095 mgm. of iodine in 100 cc. of sweat (6). Since this value is about 13% of the accepted value for plasma iodide, the 17% found in this study is rather close to the expected result. Because fibrocystics apparently secrete much greater concentrations of iodide in their sweat, it is conceivable that this mode of elimination could become an important factor in their overall iodine balance. The mechanism responsible for this abnormality is as yet unknown; and the results presented here give little help in its elucidation, besides further pointing to its diffuse manifestations. However, we feel the technique is a valuable one and we have already begun to apply it to other uses. Preliminary data on a very small series have tended to show that newborns may also secrete greater concentrations of iodide in their sweat than do normal children.

SUMMARY AND CONCLUSIONS

Thirteen children with cystic fibrosis of the pancreas and fourteen normal children were studied. After preliminary saturation of the thyroid with Lugol's solution, a tracer dose of I^{131} was administered. Sweating was encouraged with wool blankets and heating pads. The sweat was collected on gauze pads which were then centrifuged to provide the free fluid. Sweat chloride was determined as were the number of disintegrations per minute in one cc. of both sweat and serum. It was reconfirmed that fibrocystics excrete more chloride in their sweat than do normals. It was further found that fibrocystics excrete more iodide in their sweat than do normals (7).

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