SALIVARY ELECTROLYTES IN FIBROCYSTIC DISEASE OF THE PANCREAS

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There has been considerable work in recent years showing that other exocrine glands, in addition to those secreting mucus, are affected in fibrocystic disease of the pancreas.

In 1951, Kessler and Andersen showed that patients with fibrocystic disease of the pancreas are particularly liable to heat prostration during hot weather. In 1953, di Sant' Agnese, Darling, Perera and Shea reported that the sweat of fibrocystic patients contained abnormally high values for sodium and chloride, and these findings were confirmed by Shwachman, Leubner and Catzel (1955). In their original article, di Sant' Agnese *et al.* stated that not only are the sweat glands involved in fibrocystic disease of the pancreas, but there is evidence also that the parotid secretory rate is increased, and that the values for sodium and chloride in mixed saliva are elevated.

Prader, Gautier, Gautier and Naef (1955) showed that the sodium content of mixed saliva is dependent on the rate of flow of saliva, the duration of collection and the time of day of collection. They found that when all these factors were carefully controlled they were able to obtain constant results. Prader and Gautier (1955) also report that the sodium concentration of mixed saliva obtained by aspiration was increased in eleven children with cystic fibrosis of the pancreas.

McGrady and Bessman (1955) found that the chloride concentration of saliva varied greatly with the method of collection, and that consistent results were obtained only with parotid secretion. In five patients with mucoviscidosis the chloride content of parotid saliva was markedly elevated as compared with 100 controls.

The present study was undertaken to analyse the parotid secretion for electrolyte content in a number of patients with fibrocystic disease of the pancreas attending The Hospital for Sick Children, Great Ormond Street.

Method

The parotid secretion was obtained by placing a small metallic collecting device over the orifice of Stenson's duct. The device was made to adhere to the surrounding mucous membrane by suction, and the parotid saliva, uncontaminated by other salivary secretions, was easily collected.

In all cases, a few crystals of citric acid were placed on the tip of the patient's tongue in order to stimulate the salivary flow. The parotid secretion was collected for a period of one minute after the onset of flow, and usually 0·4 ml. or more of fluid was obtained. Occasionally, the collection lasted more than one minute in order to obtain a sufficient amount of secretion. In each case, the volume of fluid was carefully measured together with the length of time of collection. The secretions were analysed for sodium and potassium concentration by flame photometry, and for chloride concentration by the method of Van Slyke and Hiller (1947).

Parotid secretion was analysed by this method in 31 patients with proven fibrocystic disease of the pancreas. Sixty-three patients with various diseases in the wards of the hospital served as controls. The average age of the fibrocystic group was 6 years, with a range from 2 to 14 years. The average age of the controls was 8 years, with a range from 2 to 12 years.

The fibrocystic group consisted of 14 males and 17 females, and among the controls there were 24 males and 39 females.

Results

The values obtained are shown in Table 1 and are plotted graphically in Figs. 1, 2 and 3.

TABLE 1
ELECTROLYTE VALUES IN PAROTID SECRETION

	31 Cases of Fibrocystic Disease of the Pancreas		63 Controls	
	Average Value (mEq l.)	Range (mEq l.)	Average Value (mEq l.)	Range (mEq l.)
Sodium	26·4	6·1–60·8	14·7	1·8–64·8
Chloride	29·3	12·3–54·0	22·1	8·9–54·0
Potassium	30·2	17·5–50·5	27·7	18·5–48·0

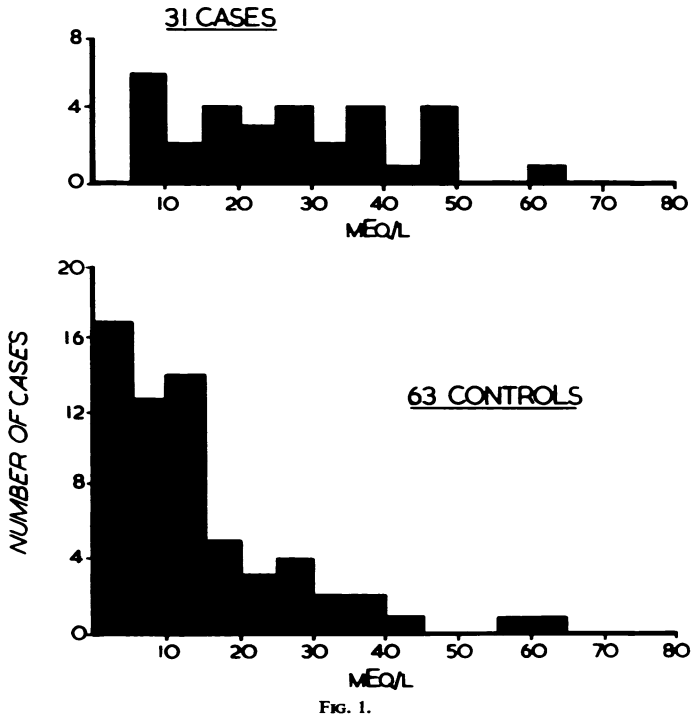

FIG. 1.

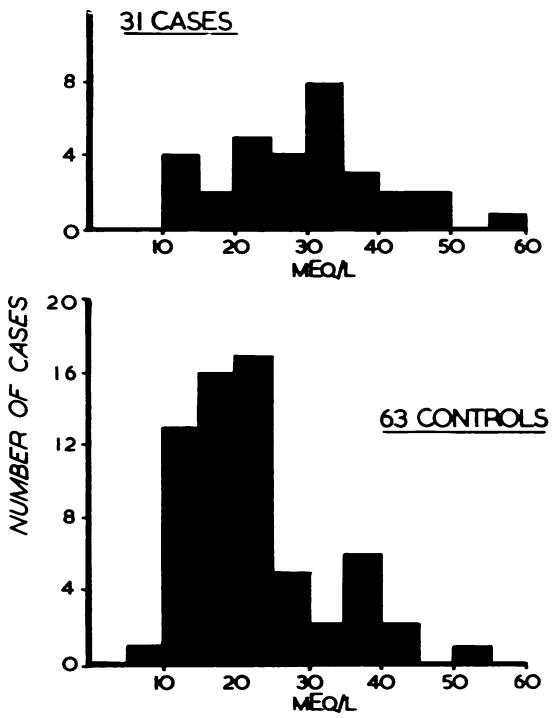

FIG. 2.

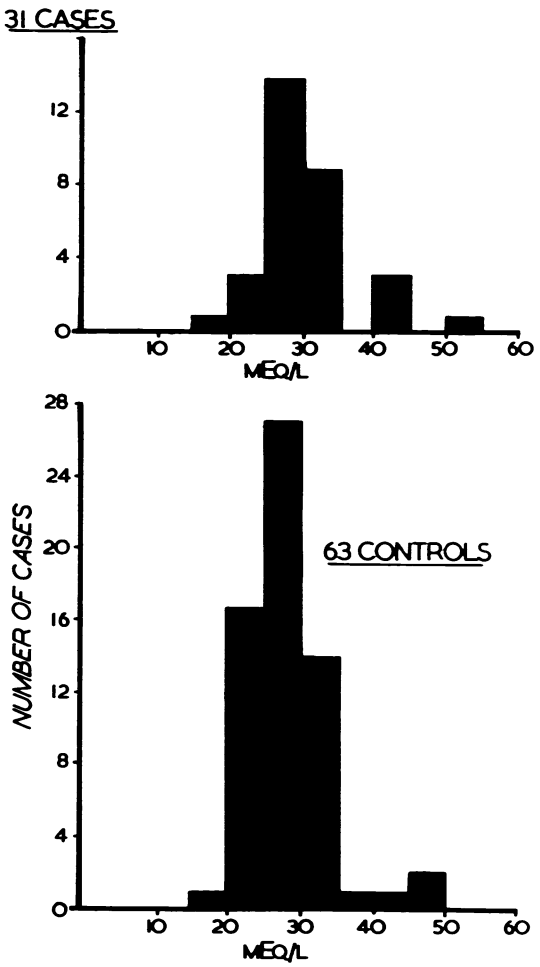

FIG 3.

Salivary electrolytes in parotid secretion in 31 cases of fibrocystic disease of the pancreas and in 63 controls.

FIG. 1.—Sodium.
FIG. 2.—Chloride.
FIG. 3.—Potassium.

The results show a considerable difference between the average concentration obtained for sodium in the cases of fibrocystic disease of the pancreas as compared with the controls: 26·4 mEq/l. and 14·7 mEq/l. respectively. However, there is a wide scatter of values, particularly among the fibrocystic group, and this results in a considerable overlap between the two groups (Fig. 1).

The difference in chloride concentrations between the controls and the fibrocystic patients is even less than for sodium, and the overlap is more marked (Fig. 2). The potassium concentrations show almost no difference between the two groups, and the patterns are practically identical (Fig. 3).

The average rate of flow among the cases of fibrocystic disease of the pancreas was more rapid than in the control group: 0·79 ml./min. for the fibrocystic patients compared with 0·55 ml./min. for the controls. Also, it was noted that the high values obtained for sodium and chloride in both groups were associated in the main with a more rapid rate of flow, and the low values obtained were associated with a slower rate of flow (Table 2). With rapid

TABLE 2
SODIUM VALUES IN PAROTID SECRETION COMPARED WITH RATE OF FLOW OF PAROTID SECRETION

Rate of of flow (ml./min.)	Average Value for Sodium (mEq/l.)		Standard Deviations	
	Fibrocystics	Controls	Fibrocystics	Controls
0·1–0·6	23·6	8·9	17·5	18·4
0·6–1·1	19·6	17·2	8·2	10·2
1·1–1·6	36·5	30·5	10·5	15·5

The chloride values showed a similar pattern, while the potassium values were not affected by the rate of flow.

rates of flow (over 0·6 ml./min.), the average values for sodium and chloride tended to be similar in the two groups, while with slow rates of flow (0·1-0·6 ml./min.), the average values were much higher in the fibrocystic group than in the controls. The values for potassium were not affected by the rate of flow.

There was no significant difference in values obtained in males and females or in the various age groups. In a number of cases, repeated determinations were made on the same patient, and the values on the whole tended to be constant. The time of day that collections were obtained made no significant difference.

Discussion

A salivary stimulant was used in our experiment in order that sufficient secretion could be obtained for analysis. We obtained a good flow in most cases by placing a few crystals of citric acid on the patient's tongue. Hildes (1955) comparing the results of two different stimuli on parotid secretion, obtained similar electrolyte values when dilute acetic acid was placed on the tongue, and when glucose candy was held in the mouth. Similarly, Gregersen and Ingalls (1931) found that the secretion of salivary electrolytes in animals stimulated by nerve excitation and by pilocarpine injections were the same.

Numerous authors in the past have shown that the sodium and chloride concentration of parotid saliva varies with the rate of flow of saliva, while the potassium concentration remains constant (Hildes, 1955; Burgen, 1956; de Beer and Wilson, 1932; Thaysen, Thorn and Schwartz, 1954). All have found that the sodium and chloride concentrations in parotid secretion are always lower than in blood serum, while the potassium concentrations are always higher. Our findings are in agreement with those in the literature in this regard.

In our experiments, concentrations of sodium and chloride tended to increase in both the fibrocystic group and the controls, as the rate of flow increased. The more rapid rate of flow on the average in the fibrocystic patients, as compared with the controls, undoubtedly accounts for some of the difference in values obtained between the two groups. However, at the slower rates of flow (0·1-0·6 ml./min.), the average values in the fibrocystic group were considerably greater than in the controls, 23·6 and 8·9 mEq l. respectively (Table 2). The standard deviations are so high that no definite conclusions can be drawn from this, but one can suppose that if a weaker stimulus had been used and slower rates of flow been obtained there might have been a greater difference in values obtained between the two groups. It is probable that the lack of concordance between our results and those of Prader and Gautier (1955) and of McGrady and Bessman (1955) is due to the difference in strength of stimulus.

The fact that we found so much overlap in our values between the fibrocystic patients and the controls makes the determination of electrolytes in parotid secretion of little practical value in the diagnosis of fibrocystic disease of the pancreas. It is likely that the analysis of mixed saliva would be of even less value as it would be more difficult to control the rate of flow.

Summary

The average concentration of sodium and chloride in stimulated parotid saliva was elevated in 31 cases of fibrocystic disease of the pancreas as compared with 63 controls. There was, however, too much

overlap between the values obtained in the two groups to make the estimation of much practical value in the diagnosis of fibrocystic disease of the pancreas. The effect of the rate of flow of saliva on the values obtained is discussed.

I wish to express my thanks to Dr. W. W. Payne for his constant supervision and helpful suggestions throughout the experiments; to Dr. A. P. Norman for allowing the analyses to be done on his patients; and to Dr. R. H. Wilkinson for his kind assistance on technical matters.

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