Secondary Chloride-losing Diarrhoea
Observations on Stool Electrolytes in Infants after Bowel Surgery

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Aaronson, I. (1971). Archives of Disease in Childhood, 46, 479. Secondary chloride-losing diarrhoea. Observations on stool electrolytes in infants after bowel surgery. Among 40 infants with postoperative diarrhoea, 3 were found to have a stool chloride concentration in excess of the sum of sodium and potassium ion concentrations. All 3 had had a recent episode of intestinal obstruction and had developed a sugar intolerance.

Congenital chloride-losing diarrhoea is a rare disorder, first described 25 years ago by Gamble et al. (1945) and Darrow (1945). In these patients, copious water stools are found to contain an unusually large amount of chloride ion, which characteristically exceeds the sum of the stool sodium and potassium ion concentrations, and is associated with hypokalaemia and a metabolic alkalosis.

After bowel operations in infants, severe diarrhoea not infrequently occurs, often for which no cause can be seen. The possibility that some abnormality might occur in the handling of chloride ion in the bowel to produce diarrhoea has led to an investigation of the stool chloride, sodium, and potassium ion concentrations in these patients. In three cases, the concentration of stool chloride was found to exceed the sum of the sodium and potassium ion concentrations, in one case by a very large amount.

Material and Method
Random stool samples, uncontaminated by urine, were collected from 40 patients under 18 months of age who had developed diarrhoea after bowel surgery. In 32 of these, operation had been undertaken for intestinal obstruction. Six of these patients had been given an ileostomy and 13 a transverse or descending colostomy. Patients with a known possible cause for the diarrhoea, e.g. a gut pathogen, sugar intolerance, or extensive bowel resection, were included in the survey. 59 separate stool samples were collected. In addition, a sample was collected for comparison from each of a further 18 patients in this age group, who were considered to be passing normal stools, 6 of which were from ileostomies and 6 from colostomies.

After homogenization and digestion by nitric acid, sodium and potassium ion concentrations were measured by flame photometry, and the chloride by titration against silver nitrate. The results were expressed in terms of stool water by calculation after drying an aliquot by water bath and a concentrated sulphuric acid chamber.

A note was made from the patient's records of the serum electrolyte values during the period of observation, and a record made of the intake of the patients during the 24 hours preceding the stool collection. Patients receiving supplementary oral chloride were excluded.

Results
The range of values obtained from all patients with diarrhoea while on a variety of feeds is shown in Fig. 1, where the stool chloride concentration in mEq/l. stool water is plotted against the sum of the sodium and potassium ion concentrations. Fig. 2 shows the range of values, similarly expressed, obtained from the control group. In all cases, serum electrolyte values were unremarkable.

The 3 patients in whom a large concentration of chloride in the stools was detected were the subject of repeated analyses and the values obtained for stool chloride, sodium, and potassium ion concentrations are recorded in Fig. 3.

Case Reports
Case 1. A male infant who developed signs of intestinal obstruction 48 hours after a normal delivery. At laparotomy, Hirschsprung's disease affecting the whole of the colon was confirmed, and an ileostomy was fashioned. Over the next week, the ileostomy actions became progressively more watery and profuse. An intolerance to disaccharides in the diet was shown,
but in spite of their withdrawal the diarrhoea continued almost unremittingly for the next 4 months.

Six samples of ileostomy fluid were analysed over this period (Fig. 3). The second sample at 4 weeks showed an abnormally high Cl concentration of 124 mEq/l., with Na 115 mEq/l. and K 5 mEq/l. This feature was again seen in the fifth sample at 13 weeks, when Cl was found to be 130 mEq/l., Na 116 mEq/l., and K 10 mEq/l. The serum electrolyte concentrations were estimated at frequent intervals, but did not show any remarkable features, and were readily maintained within normal limits by the occasional intravenous

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**Fig. 1.**—Relation of concentration of $\text{Cl}^-$ to $\text{Na}^+ + \text{K}^+$ in random stool samples from 40 infants with diarrhoea after bowel surgery.

**Fig. 2.**—Relation of concentration of $\text{Cl}^-$ to $\text{Na}^+ + \text{K}^+$ in random stool samples from patients with normal stools after bowel surgery.
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Cases 1 and 2 are exceptional because they are the only cases in which recovery was attributable directly to the introduction of lactase free feeds and parenteral electrolyte replacement. The other cases, however, although they showed significant improvement, were not conclusively proved to have been due to similar causes, since none of them was treated exclusively with these therapies.

In Case 1, the diarrhoea was associated with signs suggestive of Hirschspring's disease and the patient was found to have a Meckel's diverticulum, which was considered to be the cause of the diarrhoea. In Case 2, the diarrhoea was associated with signs of functional and structural abnormalities of the alimentary tract, but these abnormalities were not considered to be the cause of the diarrhoea.

Case 3. A male infant who developed several episodes of abdominal distension and constipation during the first week of life. He was found to have Hirschsprung's disease, and at 2 weeks a sigmoid colostomy was fashioned. The colostomy actions rapidly became very watery and by the third postoperative day intravenous hydration was necessary. An intolerance was found to have developed to both disaccharides and monosaccharides in the diet. No pathogen could be isolated from the stools. In spite of a complete withdrawal of all oral feeds and the maintenance of nutrition and hydration entirely by intravenous Aminosol Vitrum, Intralipid Vitrum, and electrolyte solutions, the diarrhoea continued unabated.

At this time, at 5 weeks of age, the first stool sample to be analysed showed the extraordinary Cl concentration of 243 mEq/l., with Na 120 mEq/l. and K 6 mEq/l. While on the same parenteral regimen, over the next 5 days there was an improvement in the diarrhoea when the stool Cl concentration fell to 108 mEq/l., with Na 110 mEq/l. and K 21 mEq/l. The third sample, 2 days later, showed this trend to be continued. Serum electrolytes were maintained throughout this period within the normal limit. The diarrhoea subsided over the next few weeks.

Over the next month, oral feeds were reintroduced, but sugars were not fully tolerated until 7 months of age. At this time, two further analyses were carried out which showed a normal electrolyte pattern. The patient has subsequently remained well and has undergone a resection of the aganglionic segment of bowel and closure of the colostomy uneventfully.

Discussion

Stool electrolytes are infrequently studied in diarrhoea. Reported observations show that chloride loss is usually low and is less than the sum of the sodium and potassium loss (Darrow and
deficiency detected. It seems reasonable to speculate that the function of a mucosal enzyme system concerned in some way with chloride transport may become similarly impaired after an episode of intestinal obstruction and lead to a secondary chloride-losing diarrhoea. The evidence (Wilson, 1962) that an active transport system is concerned with chloride absorption lends some support to this possibility.

By whatever mechanism, it seems that the appearance of an excess of chloride in the stool may not be as uncommon as had hitherto been supposed, so that examination of stools for chloride, sodium, and potassium ion content may be relevant in investigating persistent diarrhoea in infancy. Pending further understanding of this group of patients, it appears wise to ensure adequate potassium replacement whenever excessive chloride loss is encountered.

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REFERENCES


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