Comparison of oral sucrose and glucose electrolyte solutions in the out-patient management of acute gastroenteritis in infancy

By P. HUTCHINS, T. H. J. MATTHEWS, J. E. MANLY, B. LAWRIE
AND J. A. WALKER-SMITH*

Queen Elizabeth Hospital for Children, Hackney Road, London E2 8PS

SUMMARY

Seventy-three children under the age of 18 months presenting with acute gastroenteritis were given an electrolyte mixture with added sucrose or glucose in a randomized double-blind trial. The time taken to recovery in those successfully treated as out-patients was identical. However, of the 34 who received glucose, 11 (32 %) required admission compared with 7 (18 %) of the 39 who received sucrose. There was a wide range of osmolality of the made-up feeds, indicating inaccuracy in diluting the solutions as prescribed, but this did not in general correlate with need for admission.

Sucrose-electrolyte solution is at least as effective as a glucose-electrolyte solution for the out-patient management of acute gastroenteritis in infancy. The cheapness and easy availability of sucrose commends its use in developed and developing countries.

INTRODUCTION

Despite theoretical advantages for a glucose solution in the outpatient management of acute gastroenteritis in childhood, a recent study (Rahilly *et al.* 1976) at this hospital found fewer treatment failures when a sucrose solution was used. The potential importance of this finding encouraged us to verify its validity.

As sucrose is cheaper and more readily available than glucose, its clinical use would be more convenient, especially in developing countries. The osmolality of solutions made up by mothers at home was studied, and an enquiry into techniques of preparation was made. A more detailed inquiry was made concerning the reasons for failure of outpatient management in each case.

PATIENTS AND METHODS

Between 21st November 1976 and 7th February 1977, 78 children under the age of 18 months presenting to the casualty department of this hospital with a diagnosis of acute gastroenteritis were studied, and they were all seen by one of us (P.H.).

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* Correspondence should be addressed to Dr J. A. Walker-Smith, Queen Elizabeth Hospital for Children, Hackney Road, London E2 8PS.

Rectal swabs were taken from every child and, where a sufficient amount was available, the stool was examined with the electron microscope for virus particles if the child was subsequently admitted.

As is our normal practice, carbohydrate electrolyte solution 150–170 ml/kg/day was given for the first 24 h, followed by return to full strength milk usually in $\frac{1}{4}$ strength increments daily, as judged by the clinical response. The children were seen daily until clinical recovery. This was assessed on symptoms such as cessation of vomiting, good hydration, weight gain from onset, a normal stool habit and the parent's impression that their child had recovered.

Those requiring admission at a subsequent attendance were judged as clinical failures. In a randomized double-blind fashion instructions were given to add either sucrose or glucose provided in coded packets as one flat 5 ml measure (plastic teaspoon) to each 120 ml of diluted electrolyte solution.

The concentrated out-patient electrolyte mixture (OPEM) was diluted one part to five parts of boiled water.

At their second attendance within 24 h of presentation the mothers provided a sample of reconstituted feed. The osmolality was measured on the day of collection.

At the same attendance 36 unselected mothers were interviewed by a Health and Community Nutrition Sister (B.L.) to assess home hygiene and how well the feeds had been sterilized and prepared.

RESULTS

Three of the 78 children did not attend for follow up and 2 mothers did not give the carbohydrate electrolyte solution. Amongst the remaining 73 children, 57 were less than 1 year old; more were boys than girls (43:30): amongst the several ethnic groups, those of North European origin predominated. 39 children received sucrose and 34 received glucose. Samples of solutions for electrolyte analysis were provided by approximately half the patients in each group (Table 1).

Enteropathogens

Bacterial pathogens were identified in only 3 children, all successfully managed as out-patients; *Shigella sonnei, E. coli* O119 and *E. coli* O127. Rotavirus in the stools were found in two out of nine children admitted but were not looked for in those managed as out-patients.

Osmolality of solutions

Samples were available from approximately half the children in each group irrespective of success or failure and the sugar given. The ranges of osmolality are shown in Table 1. Although the range was wide, there was no significant difference between mean osmolality for failures and successes in either sucrose-treated or glucose-treated groups (Student's t test). Analysis of the differences in variances of osmolality between failures and successes of treatment showed there was no significant difference in those patients treated with the sucrose solutions. However, with the glucose solution there was a significant difference in the composition of

Table 1. *Osmolality of diluted solutions in milliosmoles per litre*

	Glucose-electrolyte mixture			Sucrose-electrolyte mixture		
	Ideally recon-stituted solution	Clinical success	Clinical failure	Ideally recon-stituted solution	Clinical success	Clinical failure
Mean	351	360	367	216	253	204
Range	—	236–453	192–590	—	168–360	145–277
No. samples	—	13	5	—	21	3

Table 2. *Clinical failures: main reasons for admission to hospital*

	Sucrose	Glucose
Social	3 single unsupported mothers 1 working mother	3 single unsupported mothers 1 both parents working: requested admission
Persistent diarrhoea and/or vomiting	1 ileus requiring intravenous fluids	1 persistent diarrhoea 1 monosaccharide intolerance requiring i.v. fluids 1 intractable vomiting requiring i.v. fluids
Intercurrent infection	1 Oral *Candida*	1 oral *Candida* 1 otitis media
Obvious feeding midmanagement	1 given rewarmed feed	1 poor sterilization 1 markedly hyperosmolar solution

the solutions as made-up by the mothers. The clinical failures had greater variance ($P < 0.01$, F test). One clinical failure had been given a markedly hyperosmolar electrolyte solution. Interrogation concerning the social and physical environment at home suggested that all except 1 child had received correctly sterilized feeds. Historically all feeds had apparently been reconstituted correctly at home, despite the range of osmolality found. One mother had been giving her infant a rewarmed feed (Table 2).

Outcome

In those children managed successfully as out-patients, the time taken to recovery was the same, both in range (2–6 days) and mean (3·65 days) for both glucose and sucrose treatment groups. Of the 73 patients 18 (25 %) were judged clinical failures. Out of the 39 who received sucrose 7 (18 %) failed clinically and were, therefore, admitted whilst 11 (32 %) of the 34 children given glucose needed admission. The difference is highly significant ($P < 0.01$, Student's t test), but because most admissions were not related to failure of treatment (Table 2) this does not necessarily imply that a sucrose electrolyte mixture is superior. It is, however, at least as effective as a glucose electrolyte mixture.

There was no correlation between ethnic group, or command of English with the clinical outcome.

DISCUSSION

A recent study by Rahilly *et al.* (1976) at this hospital recommended sucrose as the treatment of choice in the out-patient management of gastroenteritis in infancy. In view of the potential importance of this recommendation both economically and clinically, this study was repeated. Once again there were fewer clinical failures in the sucrose treated group and again there was no difference in time to recovery for both groups in those successfully managed as out-patients. However, only 5 of the 14 children who were failures were admitted solely because the symptoms of gastroenteritis continued. In the majority adverse social factors, particularly the single unsupported mother, were a major indication for admission.

In 1974, W.H.O. showed that in 22 North American and European nations gastroenteritis/diarrhoea was the sixth commonest cause of death in 1–4 year olds (W.H.O. 1974). Furthermore, approximately 500 million episodes of diarrhoea have been estimated to occur in children under 5 years in Asia, Africa and Latin America in 1975, and 5–18 million deaths as a result would have been expected in that year (Rodhe & Northrup, 1975).

The principal cause of death is dehydration in these children. Effective, early and inexpensive treatment of this dehydration is vital for the prevention of morbidity and mortality. A glucose electrolyte solution has been recommended as the most useful rehydrating fluid by Hirschhorn *et al.* (1973). Glucose activates sodium-coupled absorption reversing the net secretory state of the small intestine induced by bacterial enterotoxins, as shown initially in cholera. With this theoretical advantage as well as reports of their clinical effectiveness (Hirschhorn *et al.* 1973), glucose electrolyte solutions have been recommended (*Lancet,* 1957), and widely used in the treatment of acute gastroenteritis. Although sucrose has the theoretical drawback of requiring first, to be split by sucrase, which could be deficient in acute gastroenteritis, into glucose and fructose before absorption, sucrose electrolyte solutions do have the advantage over glucose electrolyte solutions by virtue of their lower osmolality. It is also clear that when glucose solutions are made up incorrectly there is a greater risk of producing hyperosmolar feeds. In addition fructose liberated by sucrose hydrolysis also has a similar action (Fordtran, 1975) to glucose in promoting absorption of sodium and water. Nalin (1975) has shown oral glucose to be more effective than sucrose in adults with cholera, but a study in Indonesia by Moenginah *et al.* (1975) of the use of sucrose electrolyte mixtures has been encouraging in children with diarrhoea. In a study of 20 consecutive admissions of moderate or severely dehydrated children from Calcutta nearly all under the age of two, a sucrose electrolyte mixture by nasogastric tube was shown to be effective, although it was not compared with a glucose electrolyte mixture (Chatterjee *et al.* 1977).

Our study shows that when a sucrose electrolyte solution is compared with a glucose electrolyte solution at home the sucrose solution is at least as successful in the out-patient treatment of mild gastroenteritis.

The osmolality of the solutions as made up by mothers was variable. Their descriptions of the way the feed had been made bore no relation to actual osmolality.

Errors in making up the solution may have had untoward effects on the outcome of those children managed with added glucose when a particularly high osmolality resulted and appeared to do so in one child given a hyperosmolar feeding.

Sucrose is much cheaper and more widely available than glucose and, therefore, offers considerable advantages to the developing world. Errors in making up the solution appear to be less critical in the effect on osmolality. We recommend that serious consideration be given to the addition of sucrose rather than glucose to an electrolyte mixture which is intended for the treatment of acute gastroenteritis of infancy, in both developed and developing countries.

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