Oral rehydration fluids

Oral glucose electrolyte solutions have been used in the management of acute infantile diarrhoeas since the work of Darrow in the 1940s. Until the late 1960s their use in both the United Kingdom and United States was confined largely to the management of mildly dehydrated infants and toddlers. Solutions contained less than 50 mmol/l sodium and 100–250 (2–5%) carbohydrate, as glucose or sucrose. In the late 1960s Americans working in Asia applied new physiological knowledge of the role of organic solutes in stimulating water and electrolyte absorption in patients with cholera. They showed that the massive net secretion of electrolytes and water in the small intestine could be reversed by an appropriate oral rehydration solution (ORS). These solutions contained less glucose (110 mmol/l) and more sodium (90–120 mmol/l) than the solutions used for infantile diarrhoea in the United Kingdom and the United States. Oral rehydration was then applied to infants and children with cholera and other severe diarrhoeal diseases—the consensus favouring a solution with 90 mmol/l solution.

A universal solution

In mounting a major programme for the 1980s in the treatment and prevention of dehydration in diarrhoeal diseases, the World Health Organisation (WHO) elected to promote a standard formulation of ORS, to be available in packets of dry powder made up in the field to 1 litre. In the first major publication of this programme use of this solution was recommended for both rehydration and maintenance at a rate of 100–200 ml/kg body weight/day until the diarrhoea stopped: giving up to 360 ml/kg/day in severe persistent diarrhoea. Many physicians, particularly those working in industrial countries, were concerned at the recommendation that this ORS, while appropriate for cholera in adults, should be applied as a universal treatment in infants and children. Their concern was based firstly on the knowledge that infant diarrhoeal stools contain less sodium than those of adults, while the infant is less able to deal with a sodium load and has higher water requirements; and secondly, clinical experience had shown that most morbidity and mortality from acute gastroenteritis was associated with hypernatraemia. As a result of these anxieties, pleas were made for retention of a choice of ORS.

In practice when WHO ORS has been used without an additional source of free water, occasional asymptomatic hypernatraemia has been reported. Other workers treating well nourished infants found no noticeable difference in the incidence of hypernatraemia with 90 and 50 mmol/l sodium ORS, but oedema was seen with both concentrations. Nevertheless, physicians who would have no reservations about initial rehydration with intravenous solutions of 75 mmol/l sodium have hesitated to use 90 mmol/l sodium as ORS. Pizarro et al showed the success of such an approach in both hypoa-nd hypernatraemic children. Their regimen was to give twice the estimated fluid deficit as two thirds ORS to one third water. The ORS was given undiluted for the first 6 to 8 hours of rehydration and was followed by water. The infants were then returned to undiluted breast milk or half strength formula. This regimen emphasises the use of 90 mmol/l sodium ORS for rehydration rather than for maintenance, and accords with the recent practice of prompt reintroduction of nutritious fluids in diarrhoeal disease.

Recent reviews on the epidemiology of fluid and electrolyte disturbances have highlighted the increased frequency of hyponatraemia and hypokalaemia in underdeveloped compared with developed countries. This has raised concern over the concept of the ‘universal’ ORS. Using the regimen outlined above, Santosham et al successfully treated dehydrated well nourished children from Panama and the United States. Further studies in well nourished children with diarrhoeal dehydration are clearly required, and are in progress, but this study is reassuring.

There is still some debate whether the potassium concentration in WHO ORS is suboptimal. Again, further studies are required but the present concentration of 25 mmol/l may be a sufficient compromise to allow use of WHO ORS for most patients.

Carbohydrate constituents

Most formulations of ORS have contained glucose as the carbohydrate that stimulates carrier linked sodium and water transport though galactose, some neutral amino acids, and certain other organic solutes also have the same effect. Sucrose has been used in some formulations, particularly those designed for home use, for many years but recently sucrose has been examined critically as an alternative to glucose.
Theoretical concern that reduced sucrase activity in jejunal mucosa during acute gastroenteritis might result in malabsorption, increased luminal and stool sugar concentrations, and osmotic diarrhoea have not been borne out in practice. Sucrose has been shown to be as effective as glucose in rehydration of infants and children. In many countries sucrose is more readily and cheaply available, with the added advantage that on a molar basis it provides twice the energy for a given osmolar load.

A complex carbohydrate containing some protein (rice powder) has recently been shown to be effective in ORS in mixed groups of adults and children. In many third world countries where rice is the staple diet this has obvious advantages.

**Appropriate technology?**

To overcome distribution problems of pre-packed ORS, double ended spoons to measure salt and carbohydrate have been developed. While special spoons confer a greater degree of accuracy than 'pinches' of salt and sugar, the technology is still 'foreign' and must be clearly explained. Levine et al. have shown that provided a village health worker is available to check that the correct teaspoon and domestic volume measuring device are used, a similar degree of accuracy can be achieved. The teaspoon method has the advantage of greater flexibility than the double ended spoon in that various domestic containers can be used for measuring the water. For example, in Rwanda and Zaire, 750 ml beer bottles are ubiquitous and the number of teaspoon measures of salt and carbohydrate can be adjusted accordingly. Clements et al. compared these simple sucrose/salt solutions with WHO ORS in Honduras and showed that mild to moderate dehydration could be treated successfully. Hypokalaemia was the most notable drawback and they estimated that two or three bananas would be required to provide as much potassium in the first 24 hours as ORS.

There is ample documentation of the efficacy of WHO ORS in infants and children of varying nutritional status with acute diarrhoea of different aetiology. and even neonates have been rehydrated successfully. It behoves the WHO to publicise widely the concept of using 90 mmol/l sodium ORS for dehydrated patients and not as a general purpose solution to be administered in an unsupervised manner to all patients with diarrhoea. Clearly this will require training of primary care health workers in assessing dehydration: any totally unsupervised treatment regimen is likely to fail. Based on their experiences in Bangladesh, Chen et al. have suggested that this supervision does not require a sophisticated medical set up. The regimen of Pizarro et al. obviates the need for a lower sodium solution for maintenance after rehydration, as breast milk or diluted ORS is used. The optimum treatment for the infant with continuing diarrhoea remains to be defined.

**Conclusions**

The concept of a single ORS has the obvious advantage of simplifying the delivery of effective treatment to the 500 million children throughout the world who have acute diarrhoea each year. It is to be hoped that trials in well nourished European children will resolve the reticence which European paediatricians have in recommending a 90 mmol/l sodium ORS as a superior treatment to intravenous rehydration. Given this endorsement doctors and health workers in the third world will be further encouraged to establish and extend their own rehydration programmes.

**References**

Editorial

Bêtes noires

'When the alarm goes at 2 am and I wake him to give him his medicine, he is so furious that he fights me and vomits the stuff all over me'. How many toddlers are still subjected to this barbaric ritual because a thoughtless doctor has written the prescription: drug to be given 6 hourly? Most medicines are given to children in the toddler age group and they are usually awake between 8 am and 6 pm. This gives a day of only 10 hours in which to give medicines without wakening the child. When antibiotics were first introduced there was a theory that a therapeutic concentration of antibiotic should be maintained throughout the 24 hours to avoid resistant strains emerging during troughs. There is little evidence to support this theory. Several decades of experience have shown that oral antibiotics given in three doses over the waking hours or even a single dose is effective treatment.

'Dear paediatrician, I should be grateful for your opinion on this boy of 6 who wakes intermittently in the night with pain in both shins and central abdominal pain. I have x rayed both his hips and legs and was surprised to find that they are normal.' The number of radiographs of children's legs, abdomens, and heads that could be saved if every doctor received a copy of John Apley's book on graduating must be enormous.

'I have just seen a newborn infant with a clicking hip, have asked the mother to keep him in double napkins and have made an appointment for you to see him in 6 weeks' time,' says the locum senior house officer beaming from ear to ear. Despite several studies showing that an abnormal hip can be detected visually and by palpation, there is still a common misconception that a click or audible sign indicates an abnormal hip. An audible click can be heard with normal hips and is of no pathological importance. Double napkins were introduced in an effort to abduct the hips when towelling napkins were the only form available. It was never an effective form of treatment and the use of disposable napkins for this purpose is useless. How many mothers are being worried by a suspected congenital abnormality of their infants that does not exist, and are prescribed a treatment which has no effect?

'We will make an appointment to see Johnny again in three months' time.' Does Johnny need an appointment in three months, 6 months, or ever? Once a patient steps on to the escalator of the outpatient clinic he and his parents may find it difficult to get off. Do patients with well controlled asthma, febrile convulsions, and numerous other chronic problems need to be seen at regular intervals, and if this is necessary what should be the interval? It is clearly easier to discharge a patient if there is a primary care doctor of known ability and interest in children.

Please write to us about your own bêtes noires so that we can add them to the list.

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