
Serum Electrolytes in Children Admitted with Diarrhoeal Dehydration Managed with Simple Salt Sugar Solution

KJ Nathoo, R Glyn-Jones, M Nhembe

**SUMMARY**

A study was carried out in the Paediatric Hydration Unit at Harare Central Hospital to assess the type and prevalence of electrolyte abnormalities in dehydrated children who had previously been managed with oral salt sugar solution for acute gastroenteritis. One hundred and twenty-one such referred patients had their serum urea and electrolytes estimated on admission prior to further management in the Unit; 38 (27.5%) cases of hypokalaemia, 12 (8.9%) of hypernatraemia, 5 (5.5%) of hypopatraemia and 65 (45.7%) of severe acidosis (bicarbonate level < 10 mmol/l) were documented. It is concluded that simple salt sugar solution is ideal for the prevention of dehydration but in cases of established dehydration the WHO complete formula is more appropriate for combating hypokalaemia and severe metabolic acidosis.

**INTRODUCTION**

Diarrhoeal diseases constitute a major cause of childhood morbidity and mortality in Zimbabwe. Incidence rate is estimated at 4.4 episodes per year per child under 5 years with an associated estimated mortality of 4.23 per 1,000, representing 27 per cent of all deaths of children under 5 years. Since 1982, it has been the policy in Zimbabwe to use home-based Salt Sugar Solution (SSS) as Standard Oral Rehydration Solution (ORS) therapy for both prevention and management of dehydration. The recommended method of preparation is six level teaspoons of sugar and half a level teaspoon of salt in a 750 ml bottle of water. This recipe provides 50-80 mmol of sodium/litres and approximately 80 mmol/l of sucrose. It is an incomplete formula lacking both potassium and bicarbonate, and, therefore, may not be as efficacious as complete ORS for the prevention or correction of hypokalaemia and acidosis during diarrhoea. For this reason a study was carried out to assess the type and prevalence of electrolyte abnormalities in dehydrated patients who had previously been managed with oral SSS.

**METHOD**

The study was carried out at Harare Central Hospital, where children with moderate to severe dehydration due to gastroenteritis were admitted for further management. The patients were referred by the local Municipal Clinics for failed treatment with salt sugar solution. From 14 May to end of November 1985, a total of 524 patients were admitted and of these 138 patients had their initial serum electrolytes estimated on admission. One hundred and twenty-one children were on SSS therapy prior to admission whilst the remaining 17 had not received any oral electrolyte mixtures prior to admission. Age, sex and discharge weight were recorded. On admission the mothers were questioned regarding the duration and frequency of diarrhoea and
vomiting; duration of oral rehydration therapy and the exact recipe used in the preparation of SSS.

Patients were examined at frequent intervals and fluid and electrolyte corrections were initiated orally with SSS and potassium chloride and/or intravenously with half strength Dextrose Darrows solution (Na⁺ 61 mmol/l, K⁺ 17 mmol/l, lactate 27 mmol/l, chloride 51 mmol/l, Dextrose 140 mmol/l). Breast feeding was continued and encouraged except in severe cases of dehydration where initially breast feeding was withheld for a few hours and restarted as soon as the clinical condition improved. Antibiotics were used in 17 (14%) of cases where parenteral infections like otitis media and pneumonia were present.

RESULTS

There were 76 males and 45 females in the group (121) that received SSS prior to admission. Their ages ranged from 2 months to 22 months with an average age of 11.3 months. After rehydration 74 (61%) were of normal nutritional status (weight for age), 45 (37%) were underweight and one was marasmus according to Wellcome classification.

The mean duration of diarrhoea and vomiting prior to admission was 3.1 and 2.9 days respectively. The range was one to seven days for both vomiting and diarrhoea. The mean number of liquid stools per day was five.

Biochemical findings (Table I)

Hypokalaemia (K⁺ < 3.0 mmol/l) was documented in 38 patients (27.5%). In seven patients serum potassium was less than 2 mmol/l. Hypernatraemia (Na⁺ > 150 mmol/l) was present in 12 (8.9%). One patient presented with Na⁺ level of 180 mmol/l. His mother had used 2.5 teaspoons of salt and 6 teaspoons of sugar in 750 ml of water in preparing the SSS. In seven children (5.8%) serum sodium level was found to be below 125 mmol/l.

Moderately severe metabolic acidosis with serum bicarbonate level below 10 mmol/l was noted in 62 (45.8%). In 21 the serum bicarbonate level was below 5 mmol/l. Initial serum urea level was above 13 mmol/l in 21 (17.3%).

Management and outcome

One hundred and fifteen (87%) were rehydrated with intravenous half strength Dextrose Darrows solution. In severely acidic and hypokalaemic patients, intravenous bicarbonate and potassium chloride were given in addition. Six patients were continued on oral SSS plus supplementary oral potassium chloride.

Average stay in hospital was 3.9 days. The majority of the patients, 97 (80%), were discharged on the third day. Two patients who, on admission were severely dehydrated and in shock, died within 48 hours; one had serum K⁺ level of 2 mmol/l and presented with marked hypotonia on admission.

Ninety-one (75.5%) of the patients were being breast-fed on admission. Twenty-two babies were not being breast-fed. Their average age was 18 months, an age when breast feeding tends to decline markedly in Zimbabwe.

Infants over the age of five months were all being given solids except in two where solids had been stopped after the onset of diarrhoea.

Recipes for SSS

Only one mother out of 138 did not know a recipe for the SSS. The recipes were learnt in 53 different clinics and health centres. This reflects the great mobility of our population. One hundred and thirty-seven mothers quoted eleven different recipes (Table II). One hundred and nine were using the correct standard recipe of half level teaspoon salt, 6 level teaspoons sugar and 750 ml of water.
### DISCUSSION

Oral administration of SSS is highly effective in promoting water and sodium absorption, thereby restoring vascular volume and renal perfusion. A critical drawback to the use of SSS in the management of acute diarrhoeal disease is the risk of developing hypokalaemia, since SSS is potassium free. Almost a third (27.5%) of our dehydrated children were hypokalaemic on admission. Clements et al. found hypokalaemia in patients treated with SSS therapy to be three times greater than with complete ORS WHO formula. Since SSS is the only solution being used for the prevention and management of diarrhoea in Zimbabwe, it would have been interesting to assess the frequency of hypokalaemia in the group of dehydrated children who had not received prior SSS. This unfortunately was not possible because only 17 out of 138 (12.3%) dehydrated patients were not given any SSS, indicating widespread use of SSS by the mothers. However, Onger and Barua in a similar study in Kenya in dehydrated patients who had not received prior oral rehydration therapy found 21 per cent of their patients hypokalaemic.

Since significant loss of K+ and its incomplete replacement in acute diarrhoeal disease may lead to muscle weakness, paralytic ileus and cardiac arrhythmias, potassium replacement therapy should be attempted in dehydrated patients who are on SSS. The source of K+ advocated should be cheap, easily available and well absorbed. The ideal method would be the use of complete ORS WHO formula for rehydration. Home-based oral rehydration therapy such as SSS may have considerable variations in the salt and sugar concentrations when prepared by the mothers or care-takers. Excess salt and sugar can lead to hyperosmolar solution with high sucrose and sodium concentration which may worsen the diarrhoea and induce hypernatraemic dehydration. Ransome-Kuti found that only 34 per cent of the mothers in Lagos Hospital could give correct quantities of salt-sugar for SSS. Most errors involved the use of too much salt. In contrast 78 per cent of our mothers were able to give correct recipes (Table II). Nevertheless, it is disturbing that eleven different recipes were quoted by 137 mothers. There were 131 safe recipes’ with levels of sodium ranging between 27 and 55 mmol/l. Of these, six recipes had sodium levels between 110 and 136 mmol/l, well above the WHO recommended level of 90 mmol/l.

### TABLE II - Recipe types for SSS as quoted by the mothers

<table>
<thead>
<tr>
<th>Salt</th>
<th>Sugar</th>
<th>Volume</th>
<th>No.</th>
<th>%</th>
<th>Sucrose Conc (mmol/l)</th>
<th>Na Conc (mmol/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) (0.5) tsp</td>
<td>6 tsp</td>
<td>750</td>
<td>108</td>
<td>78.2</td>
<td>54.7</td>
<td>81.8</td>
</tr>
<tr>
<td>b) (0.25) tsp</td>
<td>6 tsp</td>
<td>750</td>
<td>10</td>
<td>7.3</td>
<td>27.4</td>
<td>81.8</td>
</tr>
<tr>
<td>c) (0.25) b/top</td>
<td>3 b/top</td>
<td>750</td>
<td>6</td>
<td>4.3</td>
<td>54.7</td>
<td>83.4</td>
</tr>
<tr>
<td>d) (0.5) tsp</td>
<td>3 b/top</td>
<td>750</td>
<td>3</td>
<td>2.1</td>
<td>54.7</td>
<td>83.4</td>
</tr>
<tr>
<td>e) (0.5) tsp</td>
<td>3 tsp</td>
<td>750</td>
<td>2</td>
<td>1.4</td>
<td>54.7</td>
<td>39.0</td>
</tr>
<tr>
<td>f) 1 tsp</td>
<td>6 tsp</td>
<td>750</td>
<td>2</td>
<td>1.4</td>
<td>110.0</td>
<td>81.8</td>
</tr>
<tr>
<td>g) (0.5) b/top</td>
<td>3 b/top</td>
<td>750</td>
<td>2</td>
<td>1.4</td>
<td>110.0</td>
<td>83.4</td>
</tr>
<tr>
<td>h) 1 tsp</td>
<td>6 tsp</td>
<td>750</td>
<td>1</td>
<td>0.7</td>
<td>110.0</td>
<td>83.4</td>
</tr>
<tr>
<td>i) 2.5 tsp</td>
<td>6 tsp</td>
<td>750</td>
<td>1</td>
<td>0.7</td>
<td>136.8</td>
<td>81.8</td>
</tr>
<tr>
<td>j) (0.25) tsp</td>
<td>3 tsp</td>
<td>750</td>
<td>1</td>
<td>0.7</td>
<td>27.4</td>
<td>39.0</td>
</tr>
<tr>
<td>k) (0.5) Coca Cola top</td>
<td>1 match box</td>
<td>750</td>
<td>1</td>
<td>0.7</td>
<td>54.7</td>
<td>77.1</td>
</tr>
</tbody>
</table>

tsp = teaspoon
b/top = Mazoe bottle top
*6/137 - Sodium level > 90 mmol/l.
Hypernatraemia (Na⁺ > 150 mmol/l) was present in 12 (8.9%) of the dehydrated children, which is similar to the figure of 8 per cent reported from Kenya in children managed without oral rehydration therapy. There is definitely a need for promoting a standard method of SSS preparation nationwide. This will allow the same recipe to be taught to mothers at different clinics which in turn reinforce the acknowledged standard method of preparation. Obviously the most striking advantages of SSS are easy availability, low cost and, most important, self reliance. Early management of diarrhoeal cases with home-based therapy of SSS will prevent dehydration and reduce the severity of dehydration in majority of cases.

Recently the need for bicarbonate or a base precursor as a component of ORS has been questioned since some studies have shown that metabolic acidosis is not a severe problem (especially in non-cholera patients) and that it can be corrected by SSS. Price et al. in the United Kingdom found serum bicarbonate in their dehydrated children to be between 16 and 24 mmol/l. Islam et al. however, reported a lower mean serum bicarbonate level of 13 mmol/l in patients from Bangladesh. A similar study in Honduras showed mean serum bicarbonate level of 11.7 mmol/l and above a third of their patients had serum bicarbonate level below 10 mmol/l. Salt sugar solution was found to be as effective as the WHO complete formula for the correction of marked acidosis in this study. It appears that metabolic acidosis is a more severe problem in our patients when compared with the above studies (Table 1). Sixty-two (46%) of our patients had serum bicarbonate levels below 10 mmol/l and 21 (17%) had profound acidosis with levels below 5 mmol/l. The mean serum bicarbonate level was 9 mmol/l. These low serum bicarbonate levels would indicate the need for the inclusion of bicarbonate or some form of a base precursor in ORS in our situation.

The majority (87%) of our moderate-to-severely dehydrated patients were managed with intravenous therapy in the unit. This high usage can be curtailed by using complete WHO formula as shown by studies in various parts of the world. Pal in India found that frequent small quantities of oral rehydration therapy was effective in rehydrating and correcting electrolyte abnormalities in 92 per cent of moderate-to-severely dehydrated cholera patients aged below five years.

The complete WHO formula is regarded as the optimum solution for the management of diarrhoea. It is physiological and has appropriate electrolyte content. Constraints such as cost, unavailability of ingredients and difficulty in distribution have prevented its widespread use in some developing countries.

CONCLUSION

The present study points to a need for the use of the complete formula in children with established dehydration. Since hypokalaemia is a major serious problem encountered in dehydrated patients who had previously been treated with SSS, the following recommendations could be suggested for Zimbabwe.

a) SSS should be continued to be used for the early management of diarrhoea to prevent dehydration
b) In cases of established dehydration the WHO complete formula should be used as oral rehydration therapy at health centres, clinics and hospitals.

ACKNOWLEDGEMENTS

We are grateful to Professor FK Nkrumah for his helpful comments and to Dr Chiware, Medical Superintendent, Harare Central Hospital for allowing access to patients.

REFERENCES


Vaginal Delivery Following Caesarean Section: A Prospective Study without Radiological Pelvimetry

SP MUNJANJA, RC SEERAS, DAISY MASONA

SUMMARY

In a prospective study of trial and labour in 180 secundigravidae who had all previously delivered by caesarean section, 48.8 per cent achieved a successful vaginal delivery. The total incidence of scar dehiscence was 2.2 per cent, symptomatic scar rupture was observed in 1.1 per cent of cases. The perinatal mortality due to trial of labour was 27.7/1000 with scar rupture contributing 11.1/1000 perinatal deaths. In the patients whose trial of labour failed, significantly fewer women established strong contractions and their babies were also larger. These results were achieved without prior selection of patients according to clinical or radiological pelvimetry. It is suggested that all such secundigravidae should be given a trial of labour without prior selection unless an independent factor indicates the need for an elective Caesarean section.

Recent reviews have highlighted the success and safety of Trial of Labour (TOL) in patients previously delivered by caesarean section. In the majority of studies reviewed, either clinical or radiological pelvimetry, or both, were used to determine the suitability of the patient for a trial of labour.

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P. O. Box ST 14, Southerton,
Harare,
Zimbabwe.