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ORAL REHYDRATION OF INFANTS WITH HYPERNATREMIC DEHYDRATION DUE TO ACUTE GASTROENTERITIS*

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Twenty-five infants with hypernatremic dehydration due to acute gastroenteritis were given oral rehydration therapy (ORT). The patients received a glucose-electrolyte solution (such as that recommended by the World Health Organization) over six hours (2:1 rotating method).

Twenty-three patients were successfully rehydrated within 48 hours after onset of therapy, while the two remaining patients attained normal serum Na^+ levels within 72 hours. Acidosis was noted in 10 patients which disappeared in 24 hours.
Key words: diarrhea, dehydration, hypernatremia, oral rehydration.

Many clinical studies have established the efficacy and advantages of using oral rehydration therapy (ORT) in treating infants with diarrheal dehydration[1].

The most widely used sugar-electrolyte oral rehydration solutions (such as those recommended by the World Health Organization) contain sodium in a concentration of 90 mEq/L. Although this type of solution has been used in treating mostly patients with isonatremic dehydration, it has been reported to be just as effective when given to patients with hypernatremic dehydration[2].

Despite its disadvantages, intravenous fluid therapy is still being used by pediatricians to treat even infants with mild or moderate dehydration due to gastroenteritis[3]. Electrolyte imbalance and metabolic acidosis are the main reasons why intravenous fluid therapy should be used in a hospital ward.

A Diarrheal Diseases Training and Treatment Center has been established in the Dr. Sami Ulus Children's Hospital in Ankara with the cooperation of the Turkish Ministry of Health and UNICEF with the aim of promoting ORT as treatment for diarrheal diseases, of acquainting mothers with this treatment and instructing them on how to care for infants with acute gastroenteritis, and also to train medical personnel in the methods of treating dehydrated infants with electrolyte imbalance and metabolic acidosis.

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This study was designed to report the results obtained with ORT in the treatment of patients with hypernatremia due to acute gastroenteritis and to also emphasize the superiority of this regimen to intravenous therapy.

Material and Methods

This study consisted of 25 patients with hypernatremic dehydration due to diarrhea who were admitted to Dr. Sami Ulus Children's Hospital Diarrheal Diseases Training and Treatment Center between July-September 1991. A brief medical history was obtained for each patient and a physical examination was performed. The infants were weighed without their clothing and a venous blood sample was drawn. Any value for serum Na^+ of 150 mEq/L or above constituted hypernatremia. The degree of dehydration was determined according to the WHO criteria[4].

Three patients were given fluids intravenously during the first hour of treatment because of peripheral collapse. They then received ORS (oral rehydration solution), a WHO formula which contains Na^+: 90 mEq/L, K^+: 30 mEq/L, Cl^-: 90 mEq/L, Citrate: 10 mEq/L, and glucose: 111 mmol/L and an osmolality of 331 mosmol/L. ORS was given in a rotating manner. This glucose/electrolyte solution was followed by plain water in a volume ratio of 2:1.

A nasogastric tube was inserted in those patients who had poor oral intake. After each infant received the estimated volume of fluid required for six hours, they were given another physical examination to determine if there had been any weight gain. Laboratory tests were also performed. The infants who still showed clinical signs of dehydration were given another course of treatment with ORS. After successful rehydration, they were either breast-fed or given a half strength formula (120 ml/kg/24 hr). The glucose-electrolyte solution was administered each time the infant passed a watery stool.

Results

Twenty-five infants with hypernatremic dehydration resulting from acute gastroenteritis were evaluated. There were 18 males and 7 females. Three patients had mild, 18 moderate and 4 severe dehydration (Table I).

The mean duration of diarrhea was 4.5 days. Most patients were brought to the hospital within the first three days of onset of diarrhea. Ninety-two percent of patients were receiving breast milk and supplements, while eight percent had never received breast milk. Forty-four percent of patients were malnourished. Ten had marasmus, and one was afflicted with marasmic-kwashiorkor.

The mean serum Na^+ value was 163 ± 10.9 mEq/L (min: 150 mEq/L, max: 187 mEq/L) and the mean serum potassium value was 4.4 ± 0.8 mEq/L. During

Table I: Characteristics of Infants with Hypernatremic Dehydration Treated with Oral Rehydration

Age (mos)	No. of Patients
3-6	14 (56%)
7-10	7 (28%)
11-14	2 (8%)
15-18	2 (8%)
Total	25
Degree of Dehydration	
Mild	3 (12%)
Moderate	18 (72%)
Severe	4 (16%)
Total	25

rehydration, the serum sodium level fell at a rate of 1.33 ± 0.8 mEq/L/hr. Normal serum Na^+ levels were attained in six hours (11 patients), twelve hours (4 patients), forty-eight hours (8 patients) and in 72 hours (2 patients). Acidosis was noted in ten patients and was corrected within 24 hours. All patients were successfully rehydrated; the mean rehydration time being 10.5 ± 1.2 hrs.

Discussion

Oral rehydration therapy has been quite successful in treating isonatremic, hypernatremic, and hyponatremic dehydration in addition to metabolic acidosis occurring during diarrhea.

Hypernatremic dehydration is particularly hazardous and is often accompanied by convulsion, intracranial hemorrhage and high mortality[5,6].

Convulsions are a notable complication in hypernatremic patients receiving intravenous therapy and oral rehydration alternating with plain water[7]. Slow intravenous replacement of fluid deficits is believed to lower the risk of convulsions. Convulsions in hypernatremic patients given intravenous fluids correlate with the rate of decrease in serum Na^+. Rates of decline $\leq$ 0.5 mEq/L/hr are reported to be safe, whereas faster rates are associated with convulsions[8].

Pizarro et al[2] have previously published their experience in treating 61 infants with hypernatremic diarrheal dehydration. They used a rapid method to replace the fluid deficits which consisted of a glucose-electrolyte solution alternating with plain water.

Five infants (8%) developed convulsions. The mean rate of fall of serum Na^+ levels in these five infants with convulsions was not significantly different from the rates noted in the remaining 56 infants without convulsions. Furthermore, the five infants with convulsions had serum Na^+ levels exceeding 160 mEq/L at admission. The authors investigated if the risk of convulsion during oral rehydration therapy could be diminished by slowing down the pace of oral rehydration parallel to the rate of fall of the serum Na^+ level. The volume of orally administered fluids required to replace fluid deficits was administered over a 12-hour period rather than over a 6-hour period, as had been previously done. According to this method, infants received a volume equivalent to twice the estimated fluid deficit over nearly 12-hours. None of the 35 infants administered the slow method developed convulsions[9].

There are several factors which play a role in the development of convulsions during treatment of hypernatremic patients in addition to the rapid fall of serum Na^+ levels such as improvement of acidosis and bicarbonate plasma levels, and a decrease in plasma osmolality due to a drop in the serum urea and glucose levels[10-11].

A rapid correction of acidosis causes brain hypoxia and an increase in plasma bicarbonate concentration causes an influx of K^+ from plasma to the cells[12,13]. Major induced seizures are accompained by an efflux of K^+ from the brain[14]. It may be hypothesized that inducing a major influx of K^+ to the brain by means of administering a sufficient amount of K^+ and bicarbonate to hypernatremic patients during rehydration can prevent convulsions.

Despite increased serum Na^+ levels ($Na^+ \geqslant 160$ mEq/L) and a rapid decline in the serum Na^+ level, no convulsions were observed in our patients during the administration of the ORS regimen. We therefore believe that an adequate intake of K^+ and bicarbonate, provided by ORS, can prevent convulsions, which strongly suggests that oral rehydration of hypernatremic and acidotic patients is extremely effective and safe. We are also of the opinion that pediatricians should practice in centers such as ours to gain the experience required to treat infants with diarrheal diseases.

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