Oral Rehydration Therapy

Oley Meeting
St Petersburg Florida
July 1, 2009
Rehydration Therapy

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Cleveland Clinic

Oley Picnic July 2009
We are all water creatures.
It makes up:
50% of your body (Female)
70% of your brain
Coach: Gatorade not only quenches your thirst better, it tastes better too

Bobby: No, you people are drinkin the wrong water

Coach: Gatorade

Bobby: H2O

Coach: Gatorade

Bobby: H2O

Coach: (singing)
Water sucks, it really, really sucks!
Water sucks, it really, really sucks!
WATER ?

SPORTS DRINK ?

ORAL REHYDRATION SOLUTION ?
Intestinal Fluid Dynamics

- Sodium
- Water
- Sugar
- Osmolality
Intestinal Fluid Dynamics

Intestinal Wall

Sugar

Contents of Small Bowel

Blood

Courtesy of Darlene G Kelly MD, PhD
Intestinal Fluid Dynamics

Sugar

Contents of Small Bowel

Intestinal Wall

Blood

= Diarrhea ➔ Dehydration

Courtesy of Darlene G Kelly MD, PhD
Acute Fluid Volume Deficit

- BP low
- Heart Rate increased
- Urine output low
- Recussitate with isotonic solutions such as Ringers
Consequences of Dehydration

- Each 1% of dehydration increases body temperature by 0.1-0.2 degrees C
- Heat loss by evaporation of sweat is decreased when a person is dehydrated
- Each 1% of dehydration increases the heart rate by 4 beats per minute
- When dehydration exceeds 2% work performance is decreased

Chronic Fluid Volume Deficit

- Decreased skin turgor
- Weight loss
- Sunken eyes
- Hypothermia
- Oliguria
- Hypotension
- Tachycardia

- BUN/Cr > 15
- Hematocrit elevated (6-8 points for each liter deficit)
- Urine sp gr high
- Urinary Na < 20mEq/L
Fluid Secretion and Absorption

Ingestion
2000 mL/d water

Saliva
1000 mL/d

Bile
1000 mL/d

Gastric secretions
2000 mL/d

Intestinal secretions
1000 mL/d

Pancreatic secretions
2000 mL/d

Small intestinal absorption
7500 mL/d

Colon absorption
1000-3000 mL/d

150-200 mL/d water excreted

Ingestion + secretion = 9 L
Absorption = 8.8 L
Total fluid entering bowel 8.5 L/day

Total fluid reabsorbed 8.4 L/day
Short Bowel Jejunostomy
## Composition of Body Fluids

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Na+</th>
<th>K+</th>
<th>Cl-</th>
<th>HCO₃⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma</td>
<td>135-150</td>
<td>3.5-5</td>
<td>98-106</td>
<td>22-30</td>
</tr>
<tr>
<td>Gastric</td>
<td>10-150</td>
<td>4-12</td>
<td>120-160</td>
<td>0</td>
</tr>
<tr>
<td>Bile</td>
<td>120-170</td>
<td>3-12</td>
<td>80-120</td>
<td>30-40</td>
</tr>
<tr>
<td>Sml Int</td>
<td>80-150</td>
<td>2-8</td>
<td>70-130</td>
<td>20-40</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>25-130</td>
<td>10-60</td>
<td>20-90</td>
<td>20-50</td>
</tr>
</tbody>
</table>
Challenges in the Management of Diarrhea

- Replace Fluid Loss
- Replace Sodium (Na) Loss
Oral Rehydration Therapy

History

• **Sushruta** Indian physician – 1,000 BC
• Tepid water with rock salt and molasses

Elliott Clinical Medicine 8:296-297, 2008
Oral Rehydration Therapy

History

- **Darrow**: The retention of electrolyte during recovery from severe dehydration due to diarrhea *1946*
- **Chatterjee**: Control of vomiting in cholera and oral replacement of fluid *1953*
- **Hirschhorn**: Decrease in net stool output in cholera during intestinal perfusion with glucose containing solutions *1969*

*Elliott Clinical Medicine 8:296-297, 2008*
Sodium/Glucose Co-Transport
Oral Rehydration Therapy

History

• Mahalanabis Oral fluid therapy of cholera among Bangladesh refugees 1973
  Mortality reduced from 30% to <4%

• Journal Lancet “The discovery that sodium transport and glucose transport are coupled in the small intestine, so that glucose accelerates the absorption of solute and water was potentially the most important medical advance this century.” 1978
Oral Rehydration Solutions

Sodium balance in Short Bowel Syndrome

Oral Salt Supplements for Patients with a High Output Jejunostomy

- Extra sodium was absorbed with each form of supplement
- 2 patients receiving salt capsules vomited
- A sipped glucose salt solution seems to be the optimal mode of sodium replacement

# Oral Rehydration(?) Solutions

<table>
<thead>
<tr>
<th></th>
<th>Na</th>
<th>Carbohydrate*</th>
<th>Osmolality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mMol/L</td>
<td>gm/L</td>
<td>mOsm/kg</td>
</tr>
<tr>
<td>WHO-ORS</td>
<td>90</td>
<td>20</td>
<td>310</td>
</tr>
<tr>
<td>Rice-based</td>
<td>90</td>
<td>40</td>
<td>260</td>
</tr>
<tr>
<td>Pediatric solution</td>
<td>50</td>
<td>20</td>
<td>270</td>
</tr>
<tr>
<td>Sports drink</td>
<td>20</td>
<td>20</td>
<td>145</td>
</tr>
<tr>
<td>Ginger ale</td>
<td>3</td>
<td>90</td>
<td>540</td>
</tr>
<tr>
<td>Apple juice</td>
<td>3</td>
<td>124</td>
<td>730</td>
</tr>
<tr>
<td>Chicken broth</td>
<td>250</td>
<td>0</td>
<td>450</td>
</tr>
</tbody>
</table>
Home Recipe for ORS

1 liter water

¾ teaspoon table salt

4 tablespoons sugar (sucrose)

1 teaspoon baking powder (or ½ teaspoon baking soda)

½ teaspoon 20% potassium chloride (by prescription)

Sugar-free artificial flavoring/sweetener to taste
### WHO/UNICEF Oral Rehydration Solutions vs Home Recipe (mmol/L)

<table>
<thead>
<tr>
<th></th>
<th>Standard ORS</th>
<th>Home Recipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>90</td>
<td>98</td>
</tr>
<tr>
<td>Chloride</td>
<td>80</td>
<td>77</td>
</tr>
<tr>
<td>Glucose</td>
<td>111 (20.0 gm)</td>
<td>146 (50.2 gm) *</td>
</tr>
<tr>
<td>Potassium</td>
<td>20</td>
<td>As needed</td>
</tr>
<tr>
<td>Citrate</td>
<td>10</td>
<td>----</td>
</tr>
<tr>
<td>Osmolarity</td>
<td>311</td>
<td>321</td>
</tr>
</tbody>
</table>

* sucrose
## WHO/UNICEF Oral Rehydration Solutions (mmol/L)

<table>
<thead>
<tr>
<th></th>
<th>Standard ORS</th>
<th>Reduced osmolarity ORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>90</td>
<td>75</td>
</tr>
<tr>
<td>Chloride</td>
<td>80</td>
<td>65</td>
</tr>
<tr>
<td>Glucose</td>
<td>111 (20.0 gm)</td>
<td>75 (13.5 gm)</td>
</tr>
<tr>
<td>Potassium</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Citrate</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Osmolarity</td>
<td>311</td>
<td>245</td>
</tr>
</tbody>
</table>
Reduced Osmolarity ORS vs Standard ORS in Hospitalized Children

• Decreased stool output
• Less vomiting
• Less need for IV fluid
• No increase in hyponatremia

Cochrane Library Review Issue 2, 2009
<table>
<thead>
<tr>
<th>Component</th>
<th>Gatorade G2 + ½ tsp salt</th>
<th>Reduced osmolarity ORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>63</td>
<td>75</td>
</tr>
<tr>
<td>Chloride</td>
<td>32</td>
<td>65</td>
</tr>
<tr>
<td>Glucose</td>
<td>156 (28 gm)</td>
<td>75 (13.5 gm)</td>
</tr>
<tr>
<td>Potassium</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Citrate</td>
<td>---</td>
<td>10</td>
</tr>
<tr>
<td>Osmolarity</td>
<td>254</td>
<td>245</td>
</tr>
</tbody>
</table>
THIRST
Intestinal Rehab & Transplant Program (IRTP)

To enhance absorptive capacity, improve nutritional status, and reduce need for PN through the use of:

- Diet
- Medications
- Additional fiber
- Growth factors
- Oral rehydration solutions
- Reconstructive surgery
- Enteral Nutrition
- Small bowel or multivisceral transplant

Cleveland Clinic
The End