Potential Renal Solute Load: Considerations Relating to Complementary Feedings of Breastfed Infants

Definitions

Renal solute load (RSL) refers to all solutes of endogenous or dietary origin that require excretion by the kidneys. Potential renal solute load (PRSL) refers to solutes of dietary origin that would need to be excreted in the urine if none were diverted into synthesis of new tissue and none were lost through nonrenal routes.

\[
PRSL = \frac{N}{28} + Na + Cl + K + P_a
\]

where \( N \) is nitrogen, \( Na \) is sodium, \( Cl \) is chloride, \( K \) is potassium, and \( P_a \) is available phosphorus, and the units are in millimoles (or millioeimens) except for \( N \), which is total \( N \) in mg. The term \( \frac{N}{28} \) represents nitrogenous solutes (mmol) based on the assumption that the modal number of \( N \) atoms per molecule is 2. \( P_a \) is equal to total \( P \) except in soy-based diets, in which \( P_a \) is about two-thirds of total \( P \).

General Considerations

When an infant is well and consuming a predominantly liquid diet, the renal concentrating ability of nearly all infants is sufficient to maintain water balance even if the feeding provides a PRSL as high as that of cows’ milk. When an infant is ill, does not grow, and does not have diarrhea, PRSL is nearly the same as RSL. PRSL is an important consideration in maintaining water balance in the following 3 circumstances: 1) during acute illness, when fluid intake is decreased, especially if the illness is accompanied by fever; 2) when an energy-dense diet is fed; and 3) when renal concentrating ability is decreased, as in chronic renal disease and diabetes insipidus.

PRSL of Infant Foods

Calculations of the PRSL of various infant foods are presented in Table 1. Beikost in the United States provides 2.4 g protein per 100 kcal, which may be greater than in many lesser industrialized countries.

<table>
<thead>
<tr>
<th>Table 2. Water Balance of Six-Month-Old Breastfed Infant*</th>
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<tbody>
<tr>
<td>Effect of Feeding Beikost During Illness</td>
</tr>
<tr>
<td>Food (L/d)</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>0.50</td>
</tr>
<tr>
<td>0.35</td>
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<tr>
<td>0.65</td>
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<td>0.50</td>
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</tbody>
</table>

* The infant is afebrile and does not gain weight. Nonrenal water losses are 0.6 L/day and renal concentrating ability is 900 mosm/L and the infant concentrates the urine to this maximum.

Water Balance of Breastfed Infants in Hot Environments

A number of studies have demonstrated that nearly all breastfed infants who are otherwise well maintain satisfactory water balance in hot environments.

Water Balance During Illness

To illustrate the effect of feeding beikost on water balance during illness, Table 2 presents calculations regarding a hypothetic 6-month-old, 7-kg infant fed varying quantities of human milk and beikost. It is evident from the calculations that replacement of some of the human milk intake with beikost will have a slightly negative effect on water balance whereas increasing the total fluid intake, either by achieving greater consumption of human milk or a combination of human milk and beikost, despite a concurrent increase in PRSL, will have a major beneficial effect on water balance. Thus, during illness if the feeding of beikost is accompanied by increase in total volume of intake, water balance will be improved.

Research Questions

1. What approaches are available for increasing total fluid intakes by ill infants?
2. How should these approaches differ with respect to cultural practices and living conditions?

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REFERENCES


TABLE 1. Potential Renal Solute Load of Infant Foods

<table>
<thead>
<tr>
<th></th>
<th>PRSL* (mosm/L)</th>
<th>PRSL* (mosm/100 kcal)</th>
</tr>
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<tbody>
<tr>
<td>Human milk</td>
<td>93</td>
<td>14</td>
</tr>
<tr>
<td>Milk-based formula</td>
<td>135-260</td>
<td>20-39</td>
</tr>
<tr>
<td>Cow milk</td>
<td>308</td>
<td>46</td>
</tr>
<tr>
<td>Beikost†</td>
<td>153</td>
<td>23</td>
</tr>
</tbody>
</table>

* From Fomon and Ziegler (1999) except beikost.
† Beikost refers to the aggregate of beikost items consumed by 6-month-old infants in the United States (Fomon et al, 1990). Nutrient content per unit of beikost weight is assumed to be equal to that per unit of volume. The value for Cl (in mmol) is assumed to be the same as that for sodium.

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