Nutritional Therapy of Chronic Diarrhea

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Before one considers active nutritional therapy for a global problem as devastating and massive as chronic infant diarrhea, one should consider the preventive aspects of nutritional care. The favorable impact of breast-feeding on the incidence and course of diarrheal disease has been rediscovered and reaffirmed in most parts of the world. This very important protection provided by breast-feeding, particularly during the first very vulnerable year of life, must not be minimized. A second somewhat related preventive nutritional point concerns food as an actual source of initial, recurrent, or persistent intestinal infestation and infection in some regions of the world. We all recognize that if all babies could be breast fed and if all of their drinking water and other foods could be cleared of contamination, the incidence and severity of both acute and chronic diarrhea could be greatly reduced. The World Health Organization, through its Diarrheal Disease Control Programme, is addressing these issues.

In providing nutrients to a child at the time of a severe chronic diarrheal illness, the theoretical options are many. Foods can be given as solids or liquids, as natural, hydrolyzed, or synthetic (elemental) products, either continuously or intermittently, by the digestive tract, orally or by tube into the stomach, small intestine, or even the colon, or by peripheral or central vein. Although many questions remain, considerable advances have been made in developing concepts of the causes and mechanisms of chronic diarrhea and the accurate clinical evaluation of specific patients. At the same time, improvements have been made in products and delivery systems for active nutritional care. This volume attests to the fact that these two developments are still a long way from answering the needs of the baby with chronic diarrhea. This chapter examines some current theoretical considerations for the nutritional management of these babies. In doing so, it is essential to recognize, humbling as it may be, that we have insufficient data on which to base the formulation of sweeping feeding policies. In fact, the economic implications of special dietary care are such that inappropriate policies could be extremely counterproductive.

PATHOPHYSIOLOGICAL CHARACTERISTICS OF IDIOPATHIC CHRONIC DIARRHEA

As discussed earlier (p. 269), several specific diseases, some of which are amenable to specific dietary measures can cause chronic diarrhea, but in the
vast majority, no specific diagnosis is apparent. For these idiopathic cases, the
depth of detailed information on their gastrointestinal function will vary de-
pending on available expertise, facilities, interest, and the patient's condition.
One can safely assume, however, that a relatively extensive limitation of small
bowel absorptive function exists (2,3). If the patient is severely and chronically
undernourished, either primarily or secondary to his disease, some degree of
exocrine pancreatic insufficiency can be anticipated too (8).

As discussed earlier (p. 269), the intestinal lesion seems often to be associated
with shortened or absent villi and, therefore, loss of surface area in addition to
limited function of the enterocytes that remain. The most important consid-
eration from a dietary point of view is solute transport capacity. Impaired solute
transport causes impaired water absorption and diarrhea, so that increasing
dietary intake is likely to increase diarrhea (4). A point may be reached at which
an adequate nutrient intake is incompatible with preservation of water and
electrolyte balance, and increasing stool water losses result in dehydration. In-
creasing fat intake may increase steatorrhea, which may, in turn, induce some
ton secretion from the distal bowel, but the direct impact of unabsorbed fatty
acids on fluid losses is usually slight compared with its caloric value and with
the impact of disaccharides or monosaccharides on water losses.

An additional pathophysiological issue is the accessibility and permeability
of the mucosa to foreign proteins—potential antigens in the diet (17). Certainly,
if pancreatic insufficiency is severe, intact protein is relatively likely to reach
the mucosal surface unhydrolyzed. It has been suggested that the diseased ep-
thelium itself may be excessively permeable to protein macromolecules, but
so far, available data do not justify firm conclusions on this point. As discussed
in an earlier chapter (p. 269), the general pattern of functional abnormalities
described above is in keeping with the functional profile of incompletely dif-
fferentiated crypt-type enterocytes (9).

ACTIVE NUTRITIONAL TREATMENT

The primary goal must be to provide nutrients in sufficient quantities and
balance to provide optimal growth and development. Proposed nutrient intakes
should be based on appropriate age-related figures for the child's ideal weight,
allowing for any major fecal losses that are determined. This "truism" is em-
phasized because at times it is forgotten in the rush to undertake another in-
vestigation or to provide to the patient the latest special dietary product, even
if the latter is unpalatable or unaffordable. In addition to the obvious need to
promote the patient's growth and pancreatic recovery, adequate nutritional
intake should speed the return of normal repair and differentiation of the mucosal
epithelium (7). In an earlier chapter (p. 269), the crucial importance of mucosal
differentiation as a determinant of mucosal dysfunction and diarrhea is em-
phasized.

A second general point to emphasize is that the nutrients given to the patient
and the route chosen should fit with the perceived needs of that patient, and
wherever possible conventional foods and routes should be tried first. If the patient's digestive tract function is adequate, foods should be given by that route, even at the expense of increased fecal losses, provided fluid balance is maintained. The unnecessary use of an unpalatable, expensive, or poorly tolerated dietary product, in spite of its theoretical superiority, can result in a diminished and undesirable decrease in net intake.

**ENTERAL FEEDINGS**

The intestinal route of administration is not only relatively simple, safe, and cheap, but animal experiments have shown that nutrients assimilated by the intestine can have a greater beneficial impact on the gut than those given by vein (12–14). Earlier studies by Greene and his colleagues actually suggested an advantage of enteral over intravenous feeding in infants with severe prolonged diarrhea (6). A more recent study from the same center has shown a significant absorptive advantage of feedings given by constant drip compared with a bolus pattern in severely affected cases of chronic diarrhea (15).

In Table 1, the various forms of macronutrients available for babies are listed, and their theoretical good and bad points are summarized. In addition to the general principles already enunciated, some more specific points should be considered in providing an adequate diet that is practical for the baby.

**TABLE 1. Enteral feeding products**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Theoretical advantages</th>
<th>Theoretical disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disaccharides</td>
<td>Readily available</td>
<td>Disaccharidase deficiency common</td>
</tr>
<tr>
<td>Glucose polymer</td>
<td>Large molecule, osmol 1</td>
<td>Require amylase</td>
</tr>
<tr>
<td>Glucose</td>
<td>Directly absorbed</td>
<td>Small molecule, osmol 1 impaired transport fairly common</td>
</tr>
<tr>
<td>Fructose</td>
<td>Absorptive route differs from glucose</td>
<td>Relatively inefficient transport</td>
</tr>
<tr>
<td>Fat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long chain</td>
<td>Readily available, palatable</td>
<td>Requires pancreas, intestine for absorption</td>
</tr>
<tr>
<td>Medium chain</td>
<td>Rapidly absorbed, does not require pancreas</td>
<td>Not readily available some patients intolerant</td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole protein</td>
<td>Available, palatable</td>
<td>Requires pancreas, intestine</td>
</tr>
<tr>
<td>Hydrolysates (peptides)</td>
<td>Do not require pancreas</td>
<td>Not readily available, not palatable</td>
</tr>
<tr>
<td>Amino acids</td>
<td>No residue, readily absorbed</td>
<td>Not readily available, small molecule, osmol 1, require tube</td>
</tr>
</tbody>
</table>
The osmolality of any beverage is an important consideration in an infant with chronic diarrhea, since a hyperosmolar diet may draw fluid into the lumen in the face of defective intestinal transport. Many commonly used beverages (e.g., fruit juices, soft drinks: 700 mOsm/kg) are excessively hyperosmolar, and, if consumed full strength, they can exacerbate diarrhea in the face of compromised mucosal function (10).

Feedings should be adjusted according to the individual child's intestinal status and tolerance. If sugar appears in the stool on a sucrose diet, the use of either monosaccharides or polysaccharides can be considered. The former circumvents defective disaccharidase activity but potentially renders the feeding hyperosmolar if given in a nutritionally adequate concentration. The latter, usually given as a glucose polymer, circumvents the osmolality problem but depends on intestinal and pancreatic amylases for digestion. If the patient has severe steatorrhea on a diet containing normal long-chain triglyceride, medium-chain triglyceride substituted for long-chain fat may be better assimilated; if the steatorrhea is pancreatic, exocrine enzyme supplements can be given.

Protein sources (e.g., milk, soy) can be changed if a specific protein intolerance is suspected; protein hydrolysates, presumably nonantigenic, are given to children with suspected protein intolerance and in some cases of exocrine pancreatic insufficiency. These products are very expensive and not very palatable for older infants. Balanced amino acid mixtures are taken up by the upper intestine, where they leave no residue. They may be of value where gut capacity is severely limited or where residue is not desired. These products must be given by tube because of their taste; they too contribute substantially to the osmolality of a liquid feeding and, theoretically, should not have an absorptive advantage over di- and tripeptides.

If oral intake is inadequate (this can usually be assumed if an amino acid feed is given), tube feeding should be used. Although a variety of infant formulas can be given by small silastic nasal catheters, the elemental diets are the easiest to perfuse through these tubes for extended periods. The nasogastric route is preferable to jejunal feedings because assimilation of at least nonelemental diets is better when they are given into the stomach (16). If every absorptive advantage is needed, constant perfusion is preferable to bolus feeding.

Some micronutrients may be particularly important for the normal function and renewal of the intestine. Zinc deficiency is always mentioned in this context because of its known involvement in normal immune function (5) and its possible effect on the epithelium. Folic acid, vitamin B₁₂, and iron are among the nutrients that appear to have a particular effect on the intestinal epithelium. Few data are available, and for now the "shotgun" approach of providing abundant but not toxic quantities to these babies is appropriate.

The severely affected child's digestive tract may not tolerate even the most theoretically perfect diet given in the most careful and advantageous way. In these desperate circumstances, intravenous support can be provided either as an adjunct or as the sole source of nutrition.
TOTAL PARENTERAL NUTRITION

Clearly, this technique has saved many infants' lives by supplying total nutritional needs for extended periods of gastrointestinal malfunction (11). The technique, if available, should be used when the gastrointestinal route is judged inadequate. The advantages of providing for total nutrient needs and not relying on the gut are obvious. The disadvantages apart from cost and availability are significant. The major hazard of long-term TPN use is sepsis, although improved central line techniques and increasing use of peripheral rather than central venous routes have lessened the incidence of this complication. A second serious problem in young infants, particularly those with intestinal disease, is cholestasis, which may progress to fatal cirrhosis (1). This later unexplained complication seems to occur less frequently in babies receiving some enteral feeds than in those given nothing by mouth.

CONCLUSIONS

Nutritional therapy is an essential component of both the preventative and active management of severe chronic infantile diarrhea. Breast-feeding and hygienically prepared foods can do much to reduce the incidence and severity in many parts of the world. In the active treatment of affected patients, specific foods can seldom be identified as important causative factors, but adequate, balanced nutritional intake is undoubtedly an important component of the treatment of chronic infantile diarrhea. Over and above the obvious benefits of providing enough clean food to growing children, the theoretical possibility exists that nutrients, both macro and micro, might favorably affect intestinal renewal and differentiation, thereby hastening intestinal repair. The crucial matters of palatability, availability, and cost should not be forgotten in the drive to provide the newest and most sophisticated products. The enteric route should be used for nutrients if at all possible, and a variety of products and techniques are available to make the most of existing absorptive function. Total parenteral nutrition carries certain risks but provides a powerful tool for sustaining the most severely affected babies.

REFERENCES

6. Greene HL, McCabe DR, Menenstein GB. Protracted diarrhea and malnutrition in infancy:
changes in intestinal morphology and disaccharidase during treatment with total intravenous nutrition and elemental diets. J Pediatr 1975;87:695.


