

BRIEF REPORTS

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## Effect of Enteral and Parenteral Nutrition on Growth Parameters of Hospitalized Turkish Children

F.S. Ezgu, L. Tumer, G. Cinasal, A. Hasanoglu, M. Gunduz

Gazi University Faculty of Medicine, Department of Pediatrics, Ankara, Turkey.

Correspondence to: Faith Suheyl Ezgu, Gazi University Faculty of Medicine,  
Department of Pediatrics, Besevler 06540, Ankara, Turkey.

E-mail: fatihezgu@isbank.net.tr

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*This study was conducted to investigate growth and the complications in the hospitalized pediatric patients receiving either enteral (n = 26) or parenteral (n = 15) nutrition. Anthropometric measures as well as the results of biochemical analyses and complete blood counts were recorded. Weight, height and weight for height were expressed in z scores. The improvement in z scores for the 26 children receiving enteral nutrition in weight for age (P = 0.001), height for age (P = 0.002) and weight for height (P = 0.008) were all statistically significant. There were also significant correlations between the changes in weight for age (r<sup>2</sup> = 0.15, P = 0.0049) and height for age (r<sup>2</sup> = 0.64 and P = 0.0001) z scores and the time for follow up. Corresponding z scores in the parenteral nutrition group were not statistically significant. This study indicated that enteral nutrition provides significant improvement not only in weight but also height of sick hospitalized pediatric patients.*

**Key words:** Enteral, Growth, Nutrition, Parenteral.

**W**ITH the recognition of the untoward effects of malnutrition in hospitalized pediatric patients, enteral and parenteral nutrition have gained attention especially for the critical and chronically ill patients(1,2). The number of patients receiving enteral and parenteral nutrition in the hospital or even at home is increasing everyday(3-5). The accelerated progression in pediatric enteral

and parenteral nutrition has led to the development of new nutrition techniques such as percutaneous endoscopic gastrostomy(6).

For about two years, severely, moderately or chronically ill patients in the pediatric ward of Gazi University Hospital, have been nutritionally supported by the nutrition team of Department of Pediatric Metabolism and Nutrition. In this retrospective study, the

nutritional parameters, clinical outcomes as well as the complications of the pediatric patients receiving either enteral or parenteral nutrition were investigated during a period of two years.

### **Subjects and Methods**

#### *Enteral Nutrition Group*

A total of 36 pediatric patients received enteral nutrition between January 2000 and January 2002. Among these, 26 cases (10 females, 16 males) with median age 11.5 months (range: 1-137) who solely received enteral nutrition were included in the study. The median duration of follow-up was 21.5 days (Range: 2-547). Patients whose clinical conditions prevented oral feeding but also having an intact gastrointestinal system were chosen as candidates for enteral nutrition. The main indications for enteral feeding were loss of consciousness, lack of appetite especially during chemotherapy and neutropenia, inability in chewing or swallowing the foods, and inadequate daily oral caloric intake. The most common diseases in this group were malnutrition (26.9%), malignancy (19.2%) and inborn errors of metabolism (15.3%).

Enteral nutrition was provided by either continuous or intermittent infusions via pumps or gravity infusion sets. Silicon nasogastric feeding tubes with 6, 8 or 10 French size were used during the infusions. Standard commercial enteral feeding products having either 1 or 1.5 kcal/1 mL was used for all patients over one year of age depending on the allowed total daily fluid intake whereas human milk and elemental or semi elemental formulas were preferred for the patients under one year of age.

#### *Parenteral Nutrition Group*

This group consisted of 15 cases (5 females and 10 males) with median age 96 months (range: 4-136). The median duration

of follow-up was 10 days (range: 2-22). Patients who had disability for the use of gastrointestinal tract for feeding were given parenteral nutrition. The main indications for total parenteral nutrition were loss of consciousness, intractable vomiting, severe esophagitis and an inadequate daily caloric intake and unavailable gastrointestinal tract. The most common diseases in this group were malignancy (53.3%), gastrointestinal disease (20%) and pulmonary disease (13.3%).

Total parenteral nutrition mixtures were prepared by a compounder in a single bag with complete sterility in a computer-controlled manner. Adequate vitamins, minerals and trace elements were also supplied. All the solutions were given to the patients through an antibacterial and particle preventing filters.

The daily caloric requirement of each patient was calculated according to the formula: Recommended Nutritient intake for age  $\times$  Ideal weight for height/actual weight(3).

The diagnosis of each patient along with age, sex, weight, height, route and type of feeding were recorded. Serum electrolytes, total protein, albumin, alanine and aspartate aminotransferase, hemoglobin, mean corpuscular volume, white blood cells, platelets as well as complications and infections during the nutrition were also noted. Weight, height and weight for height were expressed in z scores using the Centers for Disease Control and Prevention anthropometric software package derived from National Center for Health Statistics growth curves.

The impact of enteral and parenteral feedings on z scores was calculated by comparing the z score at the beginning and end of the nutrition with paired t tests. The progression of z score with time was assessed using linear regression between differences in z scores and time of follow-up. SPSS 9.0

Software for Windows was used for statistical analysis.

## Results

The changes in z scores of the 26 children who received enteral feeding are shown in *Table I*. The changes in z scores of the 15 children who received parenteral feeding are shown in *Table II*.

The improvements in z scores for the 26 children receiving enteral nutrition in weight for age, height for age as well as weight for height were all statistically significant. In contrast, neither of the improvements in 15 children receiving parenteral nutrition was significant. There were also significant correlations between the changes in weight for age ( $r^2 = 0.15$ ,  $P = 0.049$ , change in weight for age =  $0.62 + 0.02 \cdot \text{time}$ ) and also height for age ( $r^2 = 0.64$  and  $P = 0.0001$ , change in height for age =  $0.22 + 0.01 \cdot \text{time}$ ) z scores and the time for follow-up in children receiving enteral nutrition.

The most common complications in the enterally fed patients with 1kcal/1 mL formula

were tube occlusion (26.92%), difficulty in transition to oral feeding (11.53%) and vomiting (7.69%) whereas tube occlusion (50%), difficulty in transition to oral/enteral feeding (15.38%) and diarrhea (3.84%) were most commonly encountered in patient fed with 1.5 kcal/1 mL containing formula. The most common complications noticed in the patients receiving total parenteral nutrition were hypophosphatemia (60%), hyperglycemia (13.3%) and cholestasis (13.3%).

## Discussion

The results of our analysis revealed that adequate enteral feeding causes significant increase not only in weight but also in height in sick children. This could be attributed to providing nearly all the required daily calories per kilograms of weight, especially by the help of high calorie (1.5 kcal/1 mL) enteral nutrition solutions without any serious complications. There were no improvements in z scores for weight for age of 9 patients with enteral nutrition but there were no loss of weight also. Enteral nutrition has been preferred as the initial route of nutritional support as it has been

**TABLE I**—Changes in z Scores [Mean  $\pm$  (SD)] of the 26 Children who Received Enteral Feeding.

	At the beginning	At the end	P value*
Weight for age (n = 26)	-2.23 (1.13)	-1.34 (1.63)	0.001
Height for age (n = 26)	-2.06 (1.04)	-1.44 (1.36)	0.002
Weight for height (n = 26)	-1.38 (1.68)	-0.84 (1.82)	0.008

\* Paired t test.

**TABLE II**—Changes in z Scores [Mean  $\pm$  (SD)] of the 15 Children who Received Parenteral Feeding.

	At the beginning	At the end	P value*
Weight for age (n = 15)	-1.44 (1.35)	-1.26 (1.29)	0.06
Height for age (n = 15)	-0.97 (1.79)	-0.94 (1.77)	0.33
Weight for height (n = 15)	-1.03 (1.45)	-0.84 (1.47)	0.11

\* Paired t test.

### Key Message

- Adequate enteral nutrition provides significant improvement not only in weight but also height of sick hospitalized pediatric patients especially by the use of high calorie solutions with negligible complications.

shown that it improves nitrogen balance, prevents gastrointestinal mucosal atrophy, decreases the frequency of bacterial translocation and septic complications, improves immune function, and reduces cost(7).

Although there were not any significant improvements in each of the z scores of the patients receiving parenteral nutrition, weight loss in 14 out of 15 patients was prevented without any significant complications. The hyperglycemia in 2 patients was treated by continuous intravenous rapid acting insulin infusions. Cholestasis in 2 patients was overcome by applying low and normal amounts of aminoacide solution alternate day. The very low rate of serious complications and prevention of infection in every patient could be due to the preparation of the solutions by using a sophisticated full-computer controlled filling system and by strictly obeying the anti-infective measures. Taylor, *et al.*(8) has also made a retrospective study on 95 children who received enteral or parenteral nutrition in intensive care unit. In the follow-up of two years, the main complication in the children who received enteral nutrition was constipation (75%), which we have never seen in our study. The reason for this finding could be that we have generally preferred an enteral solution with a higher calorie per milliliter, which also has a higher osmolarity and also could be attributed to our preference of generally continuous enteral feeding rather than intermittent. The most common complications in Taylor's study was electrolyte disturbances just as in ours.

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