SERUM ESSENTIAL AMINO ACID LEVELS OF CHILDREN WITH CHRONIC RENAL FAILURE

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SUMMARY : *We report serum essential amino acid (EAA) profiles of children with chronic renal failure (CRF) on conservative therapy. The subjects were classified according to their renal functions (group I, normal children; group II, early renal failure group, Ccr between 50-75 ml/min/m2; group III, chronic renal failure group, Ccr 5-50 ml/min/m2; group IV, end stage renal failure group on hemodialysis). Serum EAA levels were measured by high performance liquid chromatography. Serum valine levels were low only in chronic renal failure group. Other branched chain amino acids were normal in all groups. Threonine and tyrosine (which is essential in uremia) levels were decreased in all groups except normals. Serum EAA levels were higher in group IV compared with those in group III, probably due to the effect of hemodialysis . We conclude that for the management of children with CRF, EAA preparations should include more valine, threonine and tyrosine.*

Key Words : *Children, Chronic Renal Failure, Essential Amino Acids.*

INTRODUCTION

Growth failure is a common result of chronic renal failure (CRF) in childhood. Renal osteodystrophia, low protein diets, anorexia and changes in protein metabolism are the main causes of growth failure in CRF. Because adequate protein intake is necessary for growth, supplements of essential amino acids (EAA) are required with low protein diets. Although there are some reports about the dosage of EAA supplementation in childhood CRF, there is no universal agreement (5, 10).

This is the first report from Turkey about the serum EAA levels in CRF patients in childhood which can shed light on the management of CRF patients in our socioeconomic environment.

PATIENTS AND METHODS

This study was performed on normal children and CRF patients classified into three groups according to creatinine clearence calculated with the formula Ccr=Ucr x UV x 1.73 / Pcr x 1440 x body surface area. In group I (normal children) Ccr were >75 ml/min/m2, in group II (early renal failure group) 50-75 ml/min/m2, in group III (chronic renal failure group) 5-50 ml/min/min and in group IV (end stage renal failure group on hemodialysis (HD) <5 ml/min/min. Group I included 10 normal children (five boys, five girls, mean age 8.85±3.65 years); group II included five boys and four girls (six congenital renal anomalies, one Henoch Schönlein nephritis, two urolithiasis) with mean age of

8.72±4.94 years); group III included five boys and six girls (eight congenital renal anomalies, one urolithiasis, two chronic glomerulonephritis with mean age of 10.27±3.28 years) and group IV included six boys and six girls (four chronic glomerulonephritis, two urolithiasis, six congenital renal anomalies with mean age of 12.83±3.33 years). Group III and IV were on a diet with low phosphorus, low potassium and low protein (1 gr/kg). Also 1.25 DHCC, calcium carbonate and EAA tablets (1 tablet /10 kg, Fresenius AG) were given. Blood samples were drawn after an overnight fasting. In group IV patients, blood samples were drawn before and after HD. Hollow fiber cuprophane membranes according to patients' body surface area were used during HD.

Serum free amino acid determinations were done by high performance liquid chromatography with Waters Chromatography Device of Millipore Corporation (4). Mann-Whitney U test was used for data analysis (8).

RESULTS

The clinical and laboratory values are shown in Table 1. Body weight percentiles of seven patients in groups II and III and 11 patients in group IV were under the third percentile. Mean values of EAA according to groups are shown in Table 2.

When EAA values of group II were compared with group I, it was found that leucine levels were increased; threonine and tyrosine levels were decreased in group II patients. There were no differences in the comparision of groups II and III. In the comparison of groups II and IV (before HD) it was found that lysine levels were decreased in group II patients (Table 2).

	Normal Group	Group II	Group III	HD Group
Age (years)	8.85 ± 3.65 (3-16)	8.72 ± 4.94 (2-18)	10.27 ± 3.28 (6.5-15)	12.83 ± 3.33 (6.5-17)
Body weight (kg)	31.30 ± 15.98 (15-70)	22.92 ± 16.11 (9.6-30)	25.77 ± 11.03 (13-44)	28.90 ± 7.96 (15.5-43.5)
Height (cm)	134.60 ± 20.39 (98-170)	115.53 ± 29.77 (80-172)	124.09 ± 17.32 102-152)	133.5 ± 17.33 101-152)
HDSCA	1 ± 0.5	-2.46 ± 1.29	-2.33 ± 1.31	-2.40 ± 1.33
Hb (gr/dl)	13.12 ± 11.2 (11.9 ± 15.8)	10.73 ± 1.25 (8.3-11.6)	10.04 ± 2.44 (6.2-13)	8.47 ± 2.66 (5.4-14.5)
Hct (%)	38.68 ± 3.06 (34.7-46.1)	32.21 ± 3.54 (26.1-37.1)	29.75 ± 7.45 (17.9-39)	25.4 ± 7.56 (17.5-42.3)
BUN (mg/dl)	11.00 ± 2.00 (9-14)	24.22 ± 10.02 (14-44)	63.18 ± 21.65 (41-102)	93.00 ± 22.57 (58-141)
Creatinine (mg/dl)	0.86 ± 0.14 (0.7-1.1)	1.13 ± 0.28 (0.7-1.5)	2.80 ± 1.33 (1.6-6.4)	7.21 ± 2.17 (3.8-9.9)
Dietary restriction	(-)	(-)	low protein (1 gr/kg)	low protein (1 gr/kg)
EAS tb (Fresenius AG)	(-)	(-)	10 kg/1 tb	10 kg/1 tb
Number of patients in the group	10	9	11	12

Table 1 : Mean values of clinical and laboratory findings of patients according to groups.

	Group I	Group II	Group III	Group IV Before HD	Group IV After HD
Valine	18.26 ± 5.51 (5.83-24.97)	14.64 ± 9.62 (4.23-21.47)	11.99 ± 7.13[b] (3.17-23.92)	9.84 ± 6.59[fg] (10.14-29.49)	14.87 ± 4.45[dh] (6.87-22.68)
Isoleucine	5.10 ± 1.33 (7.08-3.43)	5.21 ± 3.54 (0-10.55)	5.26 ± 5.62 (0-19.26)	7.63 ± 3.61[cg] (1.43-13.82)	6.18 ± 2.10 (1.80-8.59)
Leucine	1.51 ± 2.43 (7.89-14.83)	8.06 ± 3.08[a] (4.62-14.23)	6.78 ± 3.33[b] (0-11.31)	9.86 ± 4.65[c] (2.66-18.50)	7.92 ± 2.76[d] (1.48-10.81)
Lysine	9.78 ± 1.96 (7.06-14.00)	9.00 ± 8.80 (0.49-29.82)	6.66 ± 6.30 (0-16.80)	14.75 ± 6.95[cfg] (6.43-30.08)	9.70 ± 4.49[h] 5.19-12.19)
Phenilalanine	5.25 ± 6.99 (0-19.08)	5.66 ± 3.72 (0-19.41)	6.18 ± 3.72 (0-20.41)	5.99 ± 2.44 (0-21.07)	6.01 ± 1.99 (0-20.76)
Threonine	9.55 ± 6.92 (0-22.29)	3.45 ± 7.81[a] (0-23.06)	2.90 ± 5.14[b] (0-12.61)	5.58 ± 6.71 (0-19.00)	4.54 ± 4.72 (0-10.84)
Tyrosine	6.21 ± 0.87 (4.90-7.74)	3.56 ± 4.22[a] (0-12.89)	1.99 ± 2.67[b] (0-7.50)	3.53 ± 2.48[cg] (0.99-10.10)	2.90 ± 2.19[d] (0-6.8)

(Mann-Whitney U Test) Significant difference between group I and II : a
(Mann-Whitney U Test) Significant difference between group I and III : b
(Mann-Whitney U Test) Significant difference between group I and IV before HD : c
(Mann-Whitney U Test) Significant difference between group I and IV after HD : d
(Mann-Whitney U Test) Significant difference between group II and IV before HD : f
(Mann-Whitney U Test) Significant difference between group III and IV before HD : g
(Wilcoxon Test) Significant difference between group IV before HD and IV after HD : h

Table 2 : Mean values of EAA according to groups (μmol/dl).

EAA values of group III children were compared with group I children and it was found that valine, threonine, tyrosine levels were decreased; leucine were increased. In the comparison of group III and group IV (before HD) isoleucine, lysine and tyrosine levels were significantly decreased in group III (Table 2).

EAA levels of group IV patients (before HD) were compared with group I patients, and it was found that leucine, isoleucine, lysine levels were increased while tyrosine levels were decreased in HD patients. EAA levels of group IV patients before and after HD showed that loss of lysine was significant (Table 2).

DISCUSSION

In this study serum levels of valine were normal in the early renal failure group and decreased in the chronic renal failure group in spite of the EAA supplementation, low protein diet and absent metabolic acidosis. It was shown that there was no significant valine loss during HD, contrary to the study by İkizler et al. (6). EAA tablets used in this study (containing 13.5 % valine) were not enough for valine requirements of the chronic renal failure group. Other branched-chain amino acids were normal in all groups with these EAA tablets in the given dose.

Threonine levels were decreased in early renal failure and chronic renal failure groups and tyrosine levels were decreased in all groups. Broyer (3) also reported that there are significant changes in EAA profile of CRF patients in the early phase. It was suggested that more threonine and tyrosine supplementation were required.

In HD patients, only tyrosine levels were decreased. Serum EAA levels of HD patients were higher than those of the group with chronic renal failure, in spite of the fact that there was significant loss of lysine with HD. This observation was also

reported by Rubini (7), Young (9) and Bergström (2).

We disaggree with the statement that "serum valine levels could be used as an indicator of protein-energy malnutrition". In our study, a significant decrease in valine levels was present in only chronic renal failure group although nearly all of the body weight percentiles of our patients were under the third percentile (9). This suggests that valine levels can not be an indicator of malnutrition.

For the correction of plasma EAA levels in uremia, increasing valine, decreasing leucine and isoleucine, and adding tyrosine to the EAA preparations were suggested (1). In our study we found that valine and threonine should be supplemented in chronic renal failure group and tyrosine should be supplemented in all groups.

We conclude that for management of children with CRF, EAA preparations should include more valine, threonine and tyrosine. Alternatively, the formula used in this study should be given at an increased dosage.

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