# LYSINE IN THE TREATMENT OF PROTEIN MALNUTRITION

*by*

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It has been reported that on certain low protein diets, the addition of a small amount of lysine will improve the nitrogen balance of experimental animals (ROSENBERG and CULICK, 1957). In fact, it has been reported, although not confirmed, that infants also improve when given a small amount of lysine in addition to their usual diet (ALBANESE et al., 1955).

There have been numerous accounts of childhood protein malnutrition in Bombay (PATEL et al., 1957), and its treatment (LEWIS et al., 1956). In this study mostly cases of kwashiorkor have been included, together with a few children with marasmus. The children were placed either in a control group, or were treated with small supplements of lysine.

Although lysine is present in moderate amounts in milk, it is relatively deficient in rice and vegetable proteins, so that the diet of these children, certainly deficient in protein, might also have contained an especially low amount of lysine.

## METHODS

Some 18 cases of protein malnutrition among infants were selected for this study. They all showed wasting and oedema, or wasting, or oedema with associated features. All of the children were admitted to the Hospital and alternate cases were put in the control group. All of them were given the usual hospital diet for young children. Half of the cases were given 500 mg. lysine daily for six weeks. This was administered twice a day, after the morning and evening meals.

Weights were recorded and serum proteins were estimated both at the end of three weeks and again at six weeks, as well as the start of the study. A Mantoux test was performed and none of the children with a positive reaction was included. Cases of chronic infection were also excluded, although diarrhoea was common at the time of admission and during the period of observation. One case had to be removed from the series because of the onset of measles. Many of the children were given vitamin A and D, while a few received vitamin C or B complex.

Blood was obtained by venepuncture and placed in a dry tube. The serum was separated for chemical study. The specific gravity was measured with copper sulphate and the total proteins calculated. The protein fractions were separated by electrophoresis (JENKS et al, 1955) and the percentage of each fraction determined by staining and elution.

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## RESULTS

Although these children were in poor condition and four of them had a serum albumin of less than 1 g./100 ml. of serum, there were only four deaths in the series, two in the control group and two in those receiving lysine.

Reference to Tables I a and b indicates that diarrhoea, oedema, skin changes, xerosis,

TABLE Ia. Clinical data of children on hospital diet.

| Case No. | Diarrhoea | Oedema | Skin Change | Hair Change | Xerosis (eye) | Hepat. | Miscell. | Diagnosis |
|---|---|---|---|---|---|---|---|---|
| 1 | + | ++ | + | | | | | Kwashiorkor |
| 2 | | + | + | + | + | | | Kwashiorkor |
| 3 | | ++ | + | | + | + | | Kwashiorkor |
| 4 | | + | | + | + | | | Kwashiorkor |
| 5 | + | ++ | + | | | | Drowsiness | Kwashiorkor |
| 6 | + | | + | | | + | Anaemia, Stomatitis | Kwashiorkor |
| 7 | | | + | | + | | Emaciation | Marasmus |
| 8 | + | +++ | ++ | + | | ++ | Fever, Stomatitis | Kwashiorkor |

TABLE Ib. Clinical data on children on hospital diet plus lysine.

| Case No. | Diarrhoea | Odeema | Skin Change | Hair Change | Xerosis (Eye) | Hepat. | Miscell. | Diagnosis |
|---|---|---|---|---|---|---|---|---|
| 9 | + | ++ | + | | | | Purpura | Kwashiorkor |
| 10 | + | + | | | + | | Bitot's Spots | Kwashiorkor |
| 11 | | +++ | + | + | | | | Kwashiorkor |
| 12 | + | | + | | | | Fever, Stomatitis, emaciation, Apathy | Marasmus |
| 13 | + | | + | + | | | Anaemia, Fever, Emaciation | |
| 14 | + | ++ | + | | | ++ | Anorexia | Kwashiorkor |
| 15 | | + | + | + | | + | | Kwashiorkor |
| 16 | | ++ | | | + | | Ascites, Rickets | Kwashiorkor |
| 17 | + | ++ | + | + | | | Ascites, Stomatitis, | Kwashiorkor |

TABLE IIa. Weight in lbs. of children on hospital diet.

| Case No. | Inital Wt. | wt. at 3 wks | Wt. at 6 wks. | Wt. gain in last 3 wks. |
|---|---|---|---|---|
| 1 | 17 | 20 | 21 | 1 |
| 2 | 20½ | 22 | 25 | 3 |
| 3 | 25½ | 25½ | 31½ | 6 |
| 4 | 16 | 18 | — | — |
| 5 | 25 | 26½ | 32 | 5½ |
| 6 | 26 | 26 | — | — |
| 7 | 11½ | 12½ | 13½ | 1 |
| 8 | 16 | 13 | 16 | 3 |
| Average | 18.9 | 20.4 | 23.2 | 3.2 |

depigmentation of hair, and hepatomegaly were common in both series. Anaemia, emaciation and stomatitis were also noted.

During the first three weeks, some of the children gained weight and some lost weight due to the mobilization and excretion of oedema fluid. There was not much difference in the weight record of the controls and the lysine treated group during this period (Tables II a and b). However, during the second three weeks, all of the controls gained weight, and the average was 3.2 lb. ; while in the lysine treated group two infants remained more or less stationary and one lost a considerable amount, so that the average weight change was a gain of only 1.3 lbs.

The changes in serum protein level at 3 weeks and at 6 weeks as well as the difference between the level at the beginning and at 6 weeks are given in Tables III a and b. There was a marked rise in albumin and total protein, and a fall in gamma globulin. There was also a slight rise in the beta globulins. The serum albumin and the total proteins did not rise as rapidly, or as much, in the lysine treated group as in the controls. The finding which is most interesting is the serum albumin level at 3 weeks, when the lysine treated group only rose 0.54 g. per cent.

It was also the opinion of the clinicians that those infants which received the lysine did not fare as well generally as those in the control group.

TABLE IIb. Weights in lbs of children on hospital diet plus lysine.

| Case No. | Initial Wt. | Wt. at 3 wks. | Wt. at 6 wks. | Weight gain in last 3 wks |
|---|---|---|---|---|
| 9 | 22 | 20½ | 24 | 3½ |
| 10 | 22 | 20 | 20 | 0 |
| 11 | 14 | 15 | 17 | 2 |
| 12 | 14 | 15 | 13 | -2 |
| 13 | 20 | 22½ | 24 | 1½ |
| 14 | 14 | 13 | -- | — |
| 15 | 17½ | 21½ | 21 | - ½ |
| 16 | 16 | 14½ | 17 | 3½ |
| 17 | 19 | 20 | 23½ | 3½ |
| 18 | 19½ | 25 | — | — |
| Average | 17.8 | 18.7 | 19.9 | 1.3 |

TABLE IIIa. Average serum protein levels (g./100 ml.) in children on hospital diet.

| | Total protein | Albumin | Alpha 1 globulin | Alpha 2 globulin | Beta globulin | Gamma globulin |
|---|---|---|---|---|---|---|
| Initial | 4.04 | 1.33 | 0.30 | 0.45 | 0.57 | 1.52 |
| Std. Dev. | .90 | .48 | .06 | .07 | .16 | .32 |
| Std. Error | .32 | .16 | .02 | .02 | .05 | .10 |
| 3 weeks | 5.25 | 2.36 | 0.30 | 0.64 | 0.77 | 1.12 |
| Std. Dev. | .35 | .42 | .07 | .10 | .08 | .28 |
| Std. Error | .13 | .15 | .03 | .04 | .03 | .10 |
| 6 weeks | 5.30 | 2.43 | 0.30 | 0.66 | 0.72 | 1.14 |
| Std. Dev. | .46 | .19 | .08 | .12 | .12 | .51 |
| Std. Error | .16 | .07 | .03 | .04 | .04 | .18 |
| Change | 1.26 | 1.10 | 0.00 | 0.21 | 0.15 | -.38 |
| Std. Dev. | 1.01 | .52 | .11 | .14 | .20 | .60 |
| Std. Error | .36 | .18 | .04 | .05 | .07 | .21 |

TABLE IIIb. Average serum protein levels (g./100 ml.) of children on hospital diet plus lysine.

| | Total protein | Albumin | Alpha 1 globulin | Alpha 2 globulin | Beta globulin | Gamma globulin |
|---|---|---|---|---|---|---|
| Initial | 4.50 | 1.50 | 0.32 | .058 | 0.65 | 1.33 |
| Std. Dev. | .75 | .49 | .07 | .16 | .17 | .44 |
| Std. Error | .23 | .15 | .02 | .05 | .05 | .14 |
| 3 weeks | 5.00 | 2.04 | 0.30 | 0.62 | 0.70 | 1.33 |
| Std. Dev. | .68 | .55 | .05 | .14 | .15 | .33 |
| Std. Error | .21 | .18 | .02 | .05 | .05 | .10 |
| 6 weeks | 5.30 | 2.44 | 0.27 | 0.63 | 0.75 | 1.13 |
| Std. Dev. | .30 | .41 | .05 | .14 | .07 | .17 |
| Std. Error | .09 | .12 | .02 | .04 | .02 | .05 |
| Change | 0.80 | 0.94 | −.05 | 0.05 | 0.20 | −.20 |
| Std. Dev. | .81 | .64 | .09 | .22 | .18 | .47 |
| Std. Error | .25 | .19 | .03 | .06 | .05 | .15 |

## DISCUSSION

Although it is obvious from the weight records and the serum protein figures that lysine had no favourable effect upon the course of these children, it is not so easy to determine to what extent it delayed the expected recovery.

Feeding of a disproportionate amount of a single amino acid is known to have adverse effects upon protein utilization as shown in animal experiments (ELVEHJEM and HARPER, 1955). It would seem that the human may be no exception to this general rule and that supplementation of the diet with a single amino acid must be undertaken with caution and scepticism.

In previous studies it has been shown that the addition of 25 mg. per day of chlortetracycline does have a beneficial effect upon the course of protein malnutrition (LEWIS et al., 1956), and this would certainly be more therapeutically beneficial than supplementation with a single amino acid.

## SUMMARY

The addition of 500 mg. lysine daily to the diet of infants with protein malnutrition has no beneficial effect and may delay the progress of recovery on suitable dietary regimes.

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