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POSTNATAL WEIGHT GAIN AND SERUM TOTAL PROTEIN AND ALBUMIN LEVELS IN VERY LOW BIRTHWEIGHT (≤ 1500 g) PRETERM INFANTS

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Postnatal weight gain during the first 8 weeks of life of 20 very low birthweight preterm infants (gestational age: 28.9 ± 1.7 weeks, birthweight: 1098 ± 199 g, mean ± SD) was compared to the in utero weight gain of theoretical control fetuses. By the end of the study period preterm infants gained significantly less weight than their controls (155 ± 15 vs 221 ± 16 %, $p < 0.001$). During the first 6 weeks of life daily additional weight gain of the preterm infants was less than that of the controls, but after that time no significant difference was seen (7th - 8th week: 12.0 ± 3.6 vs 13.7 ± 3.9 g/kg/day, study infants vs controls, ns). During the 7th - 8th weeks of life positive correlation was found between calorie intake and weight gain ($r = 0.33$, $F = 2.17$, $p < 0.05$). The changes in serum total protein and albumin levels, including an initial increase by the age of 2 weeks, were statistically not significant.

INTRODUCTION

With more successful treatment of the acute disorders of neonatal adaptation of preterm infants the problems of long-term management come into the foreground. Besides the relatively newly emerging problems of bronchopulmonary dysplasia or retinopathy of prematurity such old questions like optimal nutrition and postnatal growth still represent a challange to paediatricians.

Previously we have reported on some aspects of the postnatal weight gain of preterm infants during the first 4 weeks of life /5/. The present study was aimed to obtain information on the weight gain of a selected population of very low birthweight (≤1500 g, VLBW) preterm infants during a longer

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period., i.e. the first eight weeks of life. It was also investigated whether serum total protein and/or albumin levels represented reliable growth parameter or not.

PATIENTS AND METHODS

All VLBW preterm infants admitted to the Neonatal Intensive Care Unit of the Department of Paediatrics between 01.05.87. and 29. 02.88.were enrolled the study. At evaluation, however, only the data of those newborn babies were taken into account who had no congenital malformation, did not require exchange transfusion and were still hospitalized at the age of 8 weeks. Finally, data of 20 preterm infants (12 males and 8 females) with gestational age and birthweight (mean $\pm$ SD and range in parentheses) of 28.9 $\pm$ 1.7 weeks (27-32) and 1098 $\pm$ 199 g (760-1450), respectively, could be used for further analysis. Of the 20 newborns 7 were considered to be small for gestational age both by physical characteristics and by their weight for gestational age on the local growth chart ($<$ 10th percentile).

The pregnancy was complicated with pathology in half of the cases (10/20), while 8/20 newborns suffered from severe prepartal or sub partu asphyxia. Practically all VLBW preterm infants (19/20) required oxygen therapy of shorter or longer duration, and most infants (16/20) received antibiotics for proved or suspected infection.

Enteral nutrition of the preterm infants could be initiated at the age of 2 $\pm$ 1 days (1 - 3) and parenteral glucose administration could be discontinued at the age of 12 $\pm$ 7 days (5-23). Neither amino acids nor lipids were given intravenously. The infants were fed exclusively with pooled, mixed breast milk up the age of 22 $\pm$ 13 days (9-56), whereas later on some infants were given also formula (Mildibé, EGIS). All babies were fed either by bottle or gavage. They were weighed daily to an accuracy of 10 g. Total calorie intake, protein intake and protein/calorie ratio were calculated every day in each infant, considering the daily volume and quality of food consumed and/or infusion administered. The energy and protein content of the banked human milk and the formula were calculated by using reference data as to their nutrient composition. Changes in weight were summarized for two-week-long periods and were expressed both in g/kg body weight (measured at the beginning of the period)/day and in per cent of birthweight (birthweight = 100 %). Postnatal weight gain of the study infants was compared to the expected intrauterine weight gain (according to the local intrauterine growth chart) of gestational age and sex matched fetuses.

Blood samples were taken on admission, i.e. a few hours after birth, and at the ages of 2,4,6 and 8 weeks. Serum total protein levels were measured by the method of Doumas et al /4/.

Serum albumin level was calculated from total protein level and the results of electrophoretic separation /12/ of protein fractions.

For statistical analysis Student's paired and unpaired t-tests and the analysis of variance were used.

RESULTS

Biweekly mean total fluid volume, calorie and protein intake, furthermore the protein/calorie ratio in the 20 preterm infants are shown in Table I. It can be seen that by the 3rd week of life total fluid intake reached the level suggested in the literature /2/, meanwhile protein intake remained lower than that recommended for low birthweight preterm infants /3/. From the 5-6th to the 7-8th weeks of life, however, total volume intake decreased to a small, though significant extent and, thus, protein intake remained the same in spite of the higher protein/calorie ratio.

Postnatal cumulative weight gain of the study infants is compared to that of the theoretical in utero controls on Fig. 1. From the age of 2 weeks onwards, there was a steady increase in body weight of the preterm infants. By the end of the study period, however, the preterm babies gained significantly less weight than their in utero controls (155 ± 15 vs 221 ± 16 %, $p < 0.001$). When daily additional weight gain was considered (Table II) again it was found that weight gain of the preterm babies was retarded when compared to that of the control fetuses, all throughout the first 6 postnatal weeks. But after that, on the 7-8th weeks, no statistically significant difference was found in this respect between the study babies and their controls.

Postnatal changes of serum total protein and albumin levels are shown on Fig 2. Both parameters investigated increased somewhat by the age of 2 weeks and thereafter, by the age of 8 weeks, they decreased again to the initial level. The extent of these changes, however, was small and statistically not significant.

TABLE I

Total fluid volume, calorie and protein intake and protein/calorie ratio in very low birthweight ($\leq$ 1500 g) preterm infants (n = 20) during the first eight weeks of life (mean $\pm$ SD).

Age (week)	0 - 2	3 - 4	5 - 6	7 - 8
Volume intake (ml/kg/day)	141 $\pm$ 25	197 $\pm$ 21	205 $\pm$ 12	196 $\pm$ 4[x]
Calorie intake (kcal/kg/day)	87 $\pm$ 16	134 $\pm$ 15	141 $\pm$ 9	134 $\pm$ 13[x]
Protein intake (g/kg/day)	1.17 $\pm$ 0.3	2.20 $\pm$ 0.27	2.41 $\pm$ 0.2	2.42 $\pm$ 0.27
Protein/calorie ratio (g protein/100 kcal)	1.13 $\pm$ 0.2	1.63 $\pm$ 0.1	1.71 $\pm$ 0.13	1.80 $\pm$ 0.14[x]

x = $p < 0.05$ when compared to previous value

TABLE II

Additional weight gain (g/kg/day) of very low birthweight ($\leq$ 1500 g) preterm infants (n = 20) during the first eight weeks of life compared to the weight gain of control fetuses (mean $\pm$ SD).

Age (week)	0 - 2	3 - 4	5 - 6	7 - 8
Preterm infants	-0.1 $\pm$ 5.9[x]	8.7 $\pm$ 4.0[x]	13.6 $\pm$ 3.4[x]	12.0 $\pm$ 3.6
Controls	14.6 $\pm$ 4.1	16.5 $\pm$ 1.5	16.7 $\pm$ 1.4	13.7 $\pm$ 3.9

x = $p < 0.01$, preterm infants vs controls

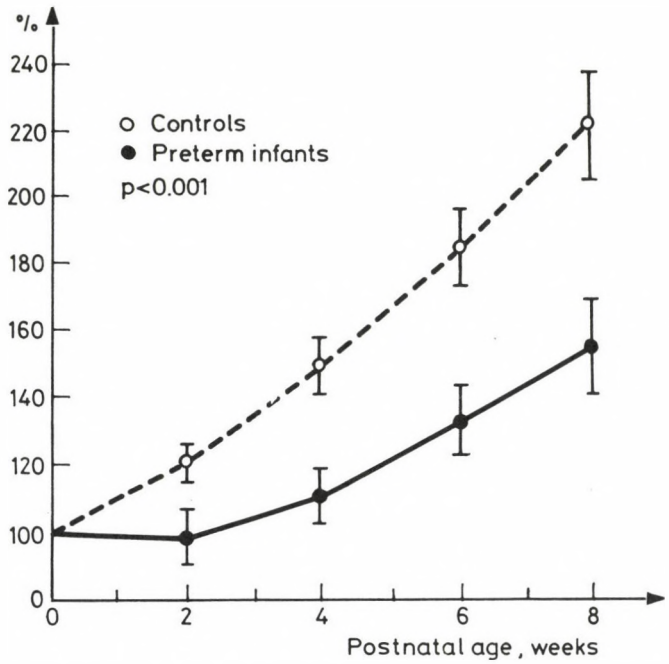

Fig. 1. Cumulative weight gain expressed as per cent of birthweight (birthweight = 100 %) of very low birthweight ($\leq$1500 g) preterm infants (n = 20) during the first eight weeks of life compared to the weight gain of the theoretical in utero controls (mean $\pm$ SD).

Multiple correlation analysis was carried out between the parameters like calorie intake, protein intake and protein/calorie ratio, on the one hand, and serum total protein and albumin levels and weight gain, on the other. No statistically significant correlation was found except between calorie intake and weight gain during the 7-8th weeks of life ($r = 0.33$, $F = 2.17$, $p < 0.05$).

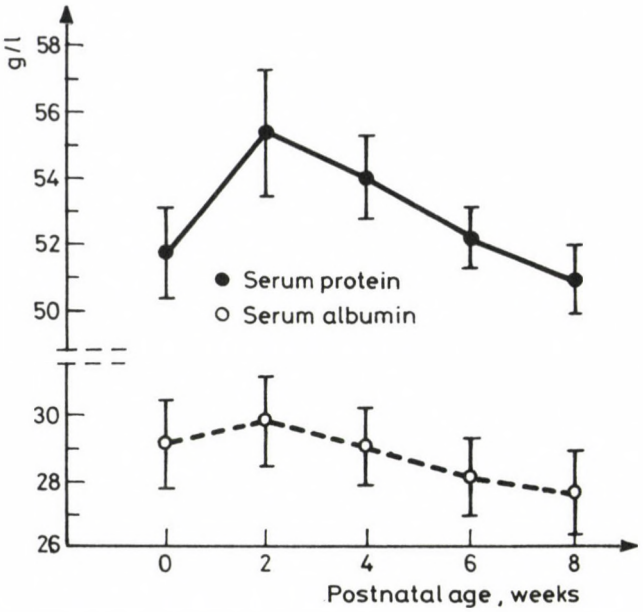

Fig. 2. Serum total protein and albumin levels in very low birthweight (≤1500 g) preterm infants (n = 20) during the first eight weeks of life (mean ± SD).

DISCUSSION

Early postnatal weight gain of preterm infants is usually measured against in utero weight gain of fetuses matched by gestational age, sex and weight percentile position. Certainly, numerous well grounded considerations question the reliability of such comparison /1,8/. Nevertheless, in lack of better alternative the principle is still widely adopted /13/.

In our previous investigations on preterm infants during the first four weeks of life we observed significantly lower weight gain of the study infants than that of the theoretical controls, either additional or cumulative weight gain was considered /5/. Cumulative weight gain of the study infants proved to be significantly lower than that of the controls in the present study too. As to additional weight gain, however,

growth performance of the study infants was lower than that of the controls up to the 7th week of life, whereas later on no difference was found. So, in this period of postnatal life the in utero growth rate is achievable even with our presently used feeding regimen.

In our previous study, in accordance with data of literature /8,9/, no close correlation was found between weight gain and calorie intake. On longer follow-up, i.e. in the present study, on the 7-8th weeks of life, however, significant positive correlation was found between calorie intake and weight gain. This positive correlation may reflect a more mature nutrient utilization of the study infants who, at the age of 8 weeks, weighed only 1705 $\pm$ 308 g but, on the average, were of 37 weeks of postconceptional age.

In spite of suggestions of amounts as high as 250 ml/kg/day /7/ or even 300 ml/kg/day /11/, it is generally agreed upon that volume intake to preterm infants should not exceed 200 ml/kg/day /2/. Thus, due to the limitation of volume intake it is the energy density of the food consumed which determines calorie intake. Since the energy density of both the pooled, mixed breast milk and the formula available (Mildibé, EGIS) is relatively low, therefore the availability of some special formula designed to meet the requirements of low birthweight preterm infants may render possible higher nutrient intake, with presumably better growth performance and shorter hospital stay.

The serum total protein and albumin levels measured in the present study were somewhat lower than those reported in the literature /6/ for a similar population of preterm infants. The early postnatal increase of total protein and albumin levels reflected most probably the postnatal restriction of extracellular fluid volume /10/. Since no correlation was found between weight gain, on the one hand, and serum total protein and albumin levels, on the other, therefore neither serum protein, nor albumin level proved to be a reliable growth parameter, at least in the life period under study.

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