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Assessment of nutritional status in preterm newborns admitted to a tertiary neonatal intensive care unit

Abstract

Introduction: The increase in survival rates of preterm newborns, especially newborns of very low birth weight and extreme low birth weight, has brought challenges to clinical practice: promoting adequate nutritional support to this population, to favor future neuropsychomotor growth and development, since the interaction between nutrition, growth, metabolic and genetic phenomena are determinant in subsequent health and quality of life.

Objectives: Evaluate the incidence of extrauterine growth restriction (EUGR) in preterm newborns and describe the evolution of anthropometric parameters during hospitalization in the neonatal unit.

Methods: Prospective cohort study included patients with birth weight ≤1500g and/or gestational age ≤32 weeks. Data collection of anthropometric parameters at birth and at hospital discharge, as well as data regarding clinical evolution and nutritional support. Descriptive statistics were used; comparisons of non-parametric data were used by the Mann-Whitney test and comparison of data matched by the Wilcoxon test, with a significance level of 5%.

Results: The incidence of EUGR was 60.5%. There was a decrease in the Z score of weight ($p<0.0001$), length ($p<0.0001$) and head circumference ($p<0.0001$), comparing birth and hospital discharge. The evolution of weight was similar to that described in the literature and nutritional management showed late onset of parenteral and enteral nutrition. Patients with complications related to prematurity had a greater difference in Z-score of weight between birth and discharge.

Conclusion: EUGR has a high incidence in preterm newborns, as a consequence of the impact of preterm birth, complications related to prematurity and nutritional practices implemented.

Keywords: extra uterine growth restriction, prematurity, neonatal care, nutrition, anthropometric assessment

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Introduction

In recent decades, the increase in survival rates of preterm newborns, especially newborns of very low birth weight and extreme low birth weight, has brought challenges to clinical practice: promoting adequate nutritional support to this population, to favor future neuropsychomotor growth and development, since the interaction between nutrition, growth, metabolic and genetic phenomena is determinant in subsequent health and quality of life.[1]

The improvement of obstetric and neonatal intensive care – such as the use of antenatal corticosteroids, ventilatory care, exogenous surfactant, parenteral nutrition, among others – is related to the fall in the mortality rate; however, it is necessary to provide means that allows an appropriate evolution of growth and development of these children, according to their genetic potential. It is often difficult to maintain adequate nutritional support, either due to the presence of clinical complications inherent to prematurity or due to inadequate management of nutritional care of the preterm newborn.[2]

The American Academy of Pediatrics recommends providing nutritional support for the preterm babies to promote the same rate of growth observed in the intrauterine environment for the corresponding gestational age, equivalent to the third trimester of pregnancy[3]. However, some authors argue that postnatal growth retardation is an inevitable condition, not only due to marked weight loss, but also to associated morbidities.[4] In addition, preterm somatic growth is strongly influenced by the extrauterine environment, adverse to nutrient incorporation, and aggravated by deficient nutritional support, slow enteral food advancement, prolonged use of parenteral nutrition and repeated episodes of food intolerance.[5]

The nutritional management of preterm newborns has been widely investigated.[6,7] The early onset of parenteral nutrition and enteral nutrition have been recommended as current good practices, providing a rapid recovery of weight and adequate weight evolution.[8] In addition to the aspects related to prematurity itself, there is significant variability in clinical practices among different units,[9,10] evidencing the lack of uniformity in the practical application of evidence and, in many cases, the limitation of access to therapeutic resources.

Thus, adequate neonatal nutrition is especially important, as well as the monitoring of anthropometric evolution. The occurrence of nutritional deviations, such as Extrauterine Growth Restriction, should be carefully diagnosed and followed, as it can lead to medium and long-term repercussions, such as hypertension and alteration of inflammatory cytokines.[11,12]

The aim of this study was to evaluate the incidence of Extrauterine Growth Restriction (EUGR) in preterm newborns admitted to

the neonatal intensive care unit and to describe the evolution of anthropometric parameters of preterm newborns during hospitalization in the neonatal unit.

Methods

Type of study

An observational, descriptive, prospective study was conducted, whose population consisted of preterm newborns admitted to the Neonatal Intensive Care Unit of a tertiary hospital in São José dos Campos – São Paulo/Brazil, from January to July 2022.

Inclusion criteria

Newborns with birth weight below 1500g and/or gestational age less than or equal to 32 weeks were included. Patients with gastrointestinal tract malformations were not included in the study as well as patients admitted to Comfort Measures Only by viability limit or major malformations.

Exclusion criteria

Patients whose guardians did not authorize participation through an Informed Consent Form and patients without anthropometric records at admission and/or hospital discharge were excluded from the study.

Data collection

Data were collected by reviewing the patient's medical records. The anthropometric measurements considered in this study were weight, length and head circumference. All of them were measured at birth, at the intervals determined by the protocols of the care unit and on the day of hospital discharge. These measurements were obtained from the procedures performed by the nursing team in the routine care and no additional manipulations of the newborns were performed.

To determine the adequacy of birth weight for gestational age, the Fenton Growth Chart[13] was used, considering Adequate for Gestational Age (AGA) between the 10th and 90th percentile, Small for Gestational Age (SGA) below the 10th percentile or Large for Gestational Age (LGA) above the 90th percentile.

The complications that could impact the weight evolution considered were early onset sepsis, late onset sepsis, necrotizing enterocolitis, bronchopulmonary dysplasia, patent ductus arteriosus, and intra-periventricular hemorrhage.

The definition of Extrauterine Growth Restriction (EUGR) for the present study was weight at hospital discharge lower than the 10th percentile for the corresponding gestational age according to gender, according to the Fenton Growth Chart.[13]

Statistical analysis

Descriptive statistics were conducted with calculation of percentages, means and standard deviations. For comparison of paired data, the Wilcoxon test was used and for comparison of non-parametric data, Mann-Whitney test was used, with a significance level of 5%, using the GraphPad Prism™ software.

Ethical aspects

The present study was submitted and approved by the Research Ethics Committee of the institution. The invitation to participate in the research, as well as the application of the Informed Consent Form, were presented to the newborn's legal guardian 48 hours after admission to the unit, allowing first the access to the baby's clinical information and the unit's routine.

Results

During the study period, 54 newborns with birth weight ≤1500g and/or gestational age less than 32 weeks and 6 days were admitted. Sixteen patients were excluded from the study due to lack of recording of anthropometric data: 7 patients died, 1 patient was transferred to another service, 4 patients had no anthropometric data on admission and 4 patients had no anthropometric data at discharge. Thirty-eight newborns were included in the study.

The mean gestational age was 30 weeks (± 2.8 weeks). At birth, the mean weight was 1.257g (± 320g), the mean length was 36.7 cm (± 3.5 cm) and the mean head circumference was 26.8 cm (± 2.3 cm). The distribution of patients according to the gestational age range and birth weight range is shown in Table 1.

Table 1 Distribution of patients according to gestational age and birth weight ranges

Gestational age ranges (weeks)	**Number of patients**	**%**
25 e 26	7	1.4%
27 e 29	8	21.1%
30 e 32	16	42.1%
33 e 36	7	18.4%
Birth weight ranges (grams)	**Number of patients**	**%**
501 a 750	2	5.3%
751 a 1000	7	18.4%
1001 a 1250	7	18.4%
1251 a 1500	15	39.5%
>1500	7	18.4%

On the day of hospital discharge, the mean gestational age was 36.6 weeks (± 2.2 weeks). The mean weight was 2.152 g (± 399.8g), the mean length was 42.7 cm (± 2.8 cm) and the head circumference was 31.1 cm (± 1.5 cm).

Considering weight, length and head circumference in relation to gestational age, according to the Fenton Growth Chart at birth and at hospital discharge, we found the distribution described in Table 2.

Table 2 Distribution according to the percentile in relation to gestational age of weight, length and head circumference at birth and discharge

	At birth		**At discharge**	
Anthropometric parameters	**N**	**%**	**N**	**%**
Weight				
Between 10th and 90th percentile	29	76.3	15	39.5
Below the 10th percentile	9	23.7	23	60.5
Length	**N**	**%**	**N**	**%**
Between 10th and 90th percentile	23	60.5	10	26.3
Below the 10th percentile	15	39.5	28	73.7
Head circumference	**N**	**%**	**N**	**%**
Between 10th and 90th percentile	28	73.7	18	47.4
Below the 10th percentile	8	21	19	50
Above the 90th percentile	2	5.3	1	2.6

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The incidence of EUGR was 60.5%. Considering the 29 patients who had birth weight between the 10th and 90th percentile, 14 (48.3%) presented with a weight at discharge lower than the 10th percentile.

Comparing the Z score of weight, length and head circumference between birth and discharge, there was a decrease in all anthropometric parameters, with statistical significance, as shown in Figures 1-3.

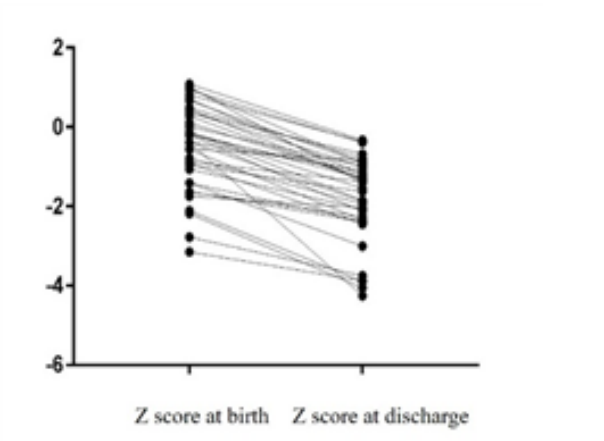

Figure 1 Comparion of weight Z-score at admission and discharge. Median difference -1.355 ($p < 0.0001$ by Wilcoxon test).

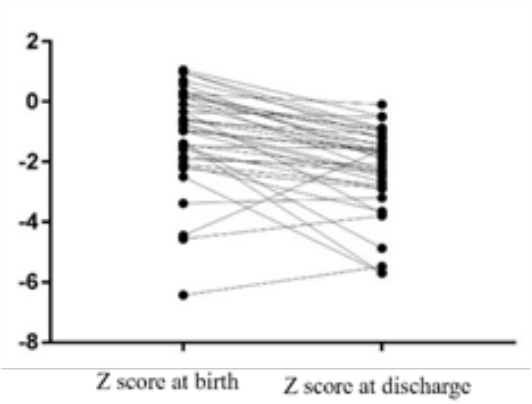

Figure 2 Comparison of length Z-score at admission and discharge. Median difference -1.225 ($p < 0.0001$ by Wilcoxon test).

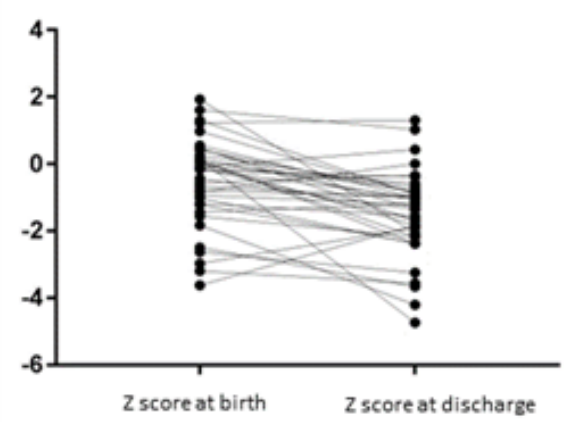

Figure 3 Comparison of head circumference Z-score at admission and discharge. Median difference -0.89 ($p < 0.0001$ by Wilcoxon test).

Regarding weight evolution, the mean weight loss in relation to birth was 9% (± 3.9%) and the mean time to regain birth weight was 14 days (± 4.8 days). The mean time to start parenteral nutrition was 32 hours (±15.5h) and the mean time of use of parenteral nutrition was 6.8 days (± 4.3 days). The enteral nutrition was started, on average, with 25.7 hours of life (± 15.2h) and the mean time to reach the full enteral nutrition was 9.4 days (± 5.1days).

Comparing the group of patients with EUGR and the group without EUGR, we found that patients with EUGR had lower birth weight and a longer time to achieve full enteral nutrition, as described in Table 3.

Table 3 Comparison of weight evolution and nutritional management between groups with EUGR and without EUGR

	Group with EUGR - n=23 Median (Interquartile Range)	**Group without EUGR - n=15 Median (Interquartile Range)**	**P value**
Birth weight (grams)	1140 (893; 1400)	1410 (1310; 1705)	0.0166*
Gestational age (weeks)	31 (27;33)	30 (29; 31)	0.1952
Weight loss (%)	9,2% (5; 12)	8,3% (5,5; 12,1)	0.7532
Time to regain birth weight (days)	13 (9; 17)	13,5 (12; 16)	0.3422
Time to start parenteral nutrition (hours)	30 (19; 36)	34 (27; 40)	0.1408
Time to start enteral nutrition (hours)	23 (14;33)	25 (16; 30)	0.5104
Time of use of parenteral nutrition (days)	6 (5;9)	5 (4; 6)	0.1274
Time to reach full enteral nutrition (days)	10 (7; 13)	7 (6; 8)	0.0144*

*Mann-Whitney

Regarding the complications during hospitalization, there was no statistically significant difference comparing the group of patients with one or more complications and the group without complications in relation to the occurrence of EUGR. It is observed, however, that the difference in Z score between birth and discharge was greater in the group that presented with complications (Figure 4).

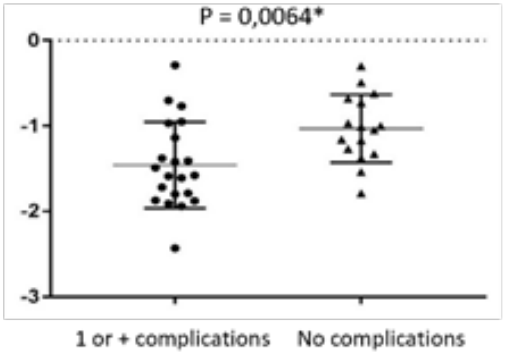

Figure 4 Difference between Z score of birth weight and in the discharge between group with complications and group without complications (*Mann Whitney).

Discussion

The nutritional management of preterm newborns is a determinant for their postnatal growth, which aims to be similar to the intrauterine life at the same gestational age, but in practice, it is difficult to achieve this goal and EUGR has been observed as a result.[14,15]

In our study, we observed that 60% of the babies presented with weight at discharge below the 10th percentile for gestational age. Figueiras-Aloy[16] showed an incidence of EUGR of 51%, using the same diagnostic criteria. Another study, which also used the weight at discharge below the 10th percentile, showed an incidence of 59.2%.[17] A study conducted in China[18] showed an incidence of EUGR greater than 70%. The diagnostic criteria of EUGR are variable in the literature and the criteria are the percentile of weight less than 10 or less than 3 (or the Z score below -1.28 or -2, respectively). The moment of measurement of the anthropometric components is also variable, with some definitions using 36 or 40 weeks of corrected gestational age or at hospital discharge.[4,19] This variability of diagnostic criteria makes it difficult to compare the incidence between the studies, however, regardless of the criteria used, it is observed that EUGR has a high incidence in preterm infants.[20,21]

It is a concerning result that almost half of the patients who had adequate birth weight for gestational age presented with weight at discharge below the 10th percentile for corrected gestational age. Considering the Z score of birth weight and weight at discharge, there was a decrease in all patients; considering the Z score of length and head circumference, there was also a decrease in most patients, evidencing a worsening of nutritional status during hospital stay and that anthropometric evolution and nutritional management are factors that require attention during hospitalization.

Weight loss in the first days of life is a physiological event related to the loss of extracellular fluid, but in preterm newborns it is more pronounced, with losses of 10 to 15%, and the time for regaining birth weight is longer, around the second or third week of life.[22,23] In our series, the percentage of weight loss and the time to regain birth weight were similar to those described in the literature, and the vast majority presented weight loss of up to 15% and recovered birth weight until the end of the third week of life.

Most preterm newborns younger than 30 weeks receive parenteral nutrition due to immaturity of the gastrointestinal tract, with difficulty in a substantial supply of nutrients by enteral route. Thus, it is recommended to start parenteral nutrition early,[24,25] with the intake of amino acids, carbohydrate and lipids, promoting protein synthesis and avoiding catabolism. In our study, the patient who started the infusion of parenteral nutrition more quickly, after birth, did so within the first 12 hours of life and most of the patients in our study began to receive parenteral nutrition on the second day of life, a very concerning result, considering current good practices, which recommend the beginning of amino acid infusion in the first hours of life,[26] due to insufficient energy reserve of these patients.[27,28]

Regarding enteral nutrition, it is currently recommended to start as early as possible[29,30] according to the clinical stability of the newborn, preferably using human milk. Prolonged fasting leads to atrophy of the intestinal mucosa and facilitates the occurrence of bacterial translocation, with development of sepsis and systemic inflammatory response syndrome. In our series, enteral nutrition was started on the first day of life in about half of the patients; in some cases, the onset was postponed due to clinical severity, but in most situations, related to the unavailability of pasteurized human milk.

Regarding the factors related to EUGR, it was observed that patients who had EUGR, especially those who had adequate birth weight for gestational age and evolved with weight at discharge below the 10th percentile, had lower birth weight and longer time to achieve full enteral nutrition. A study by Fangwen Hu[31] showed that the onset of parenteral nutrition was later, the time to reach the full enteral nutrition was longer and the protein, lipid and caloric intake was lower in the group with EUGR, compared to the group without EUGR. Suboptimal nutritional support in the first two weeks of life is one of the main factors related to EUGR.[32] One limitation of our study was not including data about caloric and protein supply during hospital stay.

In our study, we observed that babies who had one or more complications related to prematurity had a greater Z-score difference between birth and discharge than infants who had no complications. These data show the need for special care in relation to nutritional support for such patients,[33] in addition to specific therapy for each disease.

Conclusion

Extrauterine Growth Restriction has a high incidence in preterm newborns, as a consequence of the impact of premature birth, complications related to prematurity and nutritional practices implemented. The careful evaluation of anthropometry, during the period of hospital stay and in the follow-up after discharge, is important to detect and monitor EUGR, using adequate growth charts for the population of preterm infants. Special attention should be given to nutritional support, enabling the early onset of parenteral nutrition, allowing an adequate caloric, protein and lipid intake to avoid initial catabolism and ensure growth. Enteral nutrition should also be initiated as early as possible, according to clinical stability and prioritizing breastfeeding. Careful nutritional management is necessary in patients with complications related to prematurity.

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Conflicts of interest

There are no conflicts of interest regarding the authors.

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