The Importance of Early Nutritional Management of Low-birthweight Infants

William C. Heird, MD*

Concerns About Early Nutritional Management

A number of reasons for concern about early nutritional management of very low birthweight (VLBW) infants, particularly extremely low birthweight (ELBW) infants, are enumerated by the authors of the articles in this issue. These include the possibilities that current management practices result in excessive losses of limited endogenous nutrient stores, fail to preserve host defense mechanisms, and do not promote normal growth and development of the central nervous system. An additional related concern is that these practices result in growth deficits of sufficient magnitude to prevent or hinder achievement of the infants’ growth potential.

As Thureen notes, a number of studies have shown that reasonably stable infants who receive no protein or amino acid intake during the initial 7 to 10 days of life lose at least 1% of endogenous protein stores daily. Furthermore, Premer and Georgieff suggest that sick infants may lose even more protein stores. Clearly, this loss cannot continue for long without severely depleting muscle mass that, in turn, results in muscle fatigue, failure, or both. Acute and chronic malnutrition also can compromise host defense mechanisms, thereby decreasing the ability to resist infection. Both results clearly are undesirable, and many believe that poor early nutritional management of ELBW and VLBW infants may contribute to this population’s high incidence of respiratory problems and infection. Interestingly, the most common remedy for poor growth—increasing energy intake—does little to preserve lean body mass, although it may preserve or increase fat mass.

Impact on the Central Nervous System

The impact of inadequate early nutrition on growth and development of the central nervous system is of particular concern. A large body of data, primarily from animals but some from human infants, has demonstrated that if malnutrition is not corrected during a critical period of brain growth and development, deficits may not be recoupable. In the human infant, this “critical” period for growth of the entire brain is believed to span at least the first 18 months of life. Thus, correction of early malnutrition before 18 months of age theoretically should circumvent overall deficits. However, specific areas throughout the brain have critical periods that end at various points within this time period, and little is known about the effects of malnutrition during the “critical period” of any single brain area.

Because growth and development of the central nervous system is particularly rapid during the third trimester of gestation, it seems reasonable to assume that the impact of inadequate nutrition during any portion of this period, whether it occurs in utero or ex utero, is likely to be particularly detrimental. In fact, the generally poor cognitive development of ELBW and VLBW infants often is attributed, in part, to their poor early nutritional management. In addition, a lower-than-normal head circumference at 8 months of age, which is related to early growth and, hence, early nutrition, appears to be a primary predictor of poor neurodevelopmental outcome.

Impact on Subsequent Needs

The impact of early nutritional management on subsequent needs, although potentially very important, has received limited attention. For example, VLBW infants who do not regain birthweight until 3 to 5 weeks of age, even if they experience intrauterine rates of growth and nitrogen retention after this time period, will continue to lag 3 to 5 weeks behind the fetus of comparable postconceptional age. Although some or all of this deficit can be recouped, most follow-up studies show that many ELBW and VLBW infants remain small, even into adolescence. This raises the possibility that there is a “critical window” for catch-up and that those who do not catch-up during this time never may do so. Thus, the amount of growth deficit that must be regained may be an important determinant of whether the deficit actually is recouped. For example, the infant who receives no amino acid or protein intake for the first week of life incurs a protein deficit of about 21 g/kg (1 g/kg per day of endogenous protein losses plus failure to deposit protein at the intrauterine rate of about 2 g/kg per day). Many current nutritional management strategies for LBW infants easily can result in a cumulative protein deficit of 30 to 40 g/kg before adequate enteral intake is achieved (at least 2.8 g/kg per day of protein and 100 to 120 kcal/kg per day) to support intrauterine rates of weight gain and nitrogen retention.

It is important to note that the nutrients required to recoup the early deficits are additional to those required for maintenance. Further, because only about 75% of protein intake is retained, the requirement for replacing a cumulative protein deficit of 30 to 40 g/kg is 40 to 55 g/kg. Hence, the requirement to correct the deficit over a 40-day period is an additional protein intake of 1 to 1.4 g/kg per day or a total protein intake of 3.8 to 4.2 g/kg per day. The requirements for replacing the deficit over a longer period obviously will be less, but the possibility of a critical period for achieving catch-up must be considered.

*Professor of Pediatrics, Children’s Nutrition Research Center, Baylor College of Medicine, Houston, TX.
Requirements for replacing the early protein deficit sooner will be greater.

Unfortunately, formulas currently available for feeding ELBW and VLBW infants, unless fed at volumes of 180 to 200 mL/kg per day, provide only about 3.2 to 3.6 g/kg per day of protein. Thus, infants who are fed these formulas cannot recover a protein deficit of 40 g/kg within 40 days. Rather, they still will have a protein deficit of 8 to 24 g/kg at the end of this period. This highlights the importance of improving nutritional management of ELBW and VLBW infants during hospitalization so as to minimize the deficit that must be regained. It also illustrates the importance of postdischarge nutrition in those who have not recouped early deficits by discharge.

**Conclusion**

Clearly, the issue of more optimal nutritional management of preterm infants is not simple. Data concerning safety and efficacy of a more aggressive approach are scarce. Nonetheless, such an approach seems logical. At the least, it is likely to reduce hospital stay and, thereby, the cost of hospitalization. In addition, because epidemiologic data suggest that small size both at birth and at 1 year of age is associated with higher rates of diabetes, hypertension, and stroke in later life, more aggressive early nutritional management may have lifelong benefits. This is particularly true if the effect of size at birth and at 1 year of age are additive, as appears to be the case.

**SUGGESTED READING**


The Importance of Early Nutritional Management of Low-birthweight Infants
William C. Heird
Pediatrics in Review 1999;20;e43
DOI: 10.1542/pir.20-9-e43

Updated Information & Services
including high resolution figures, can be found at:
http://pedsinreview.aappublications.org/content/20/9/e43

References
This article cites 3 articles, 1 of which you can access for free at:
http://pedsinreview.aappublications.org/content/20/9/e43#BIBL

Permissions & Licensing
Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
http://classic.pedsinreview.aappublications.org/site/misc/Permissions.xhtml

Reprints
Information about ordering reprints can be found online:
http://classic.pedsinreview.aappublications.org/site/misc/reprints.xhtml
The Importance of Early Nutritional Management of Low-birthweight Infants
William C. Heird

*Pediatrics in Review* 1999;20;e43
DOI: 10.1542/pir.20-9-e43

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pedsinreview.aappublications.org/content/20/9/e43