Nutritional Deficiencies During Critical Illness

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• Critical care • Children • Malnutrition
• Deficiency • Nutrition

Awareness of the deleterious consequences of malnutrition during critical illness and the will to prioritize nutritional therapy are necessary first steps toward addressing this problem. Careful attention to preexisting malnutrition, regular and accurate assessment of nutritional requirements, and accurate measurement of energy expenditure in some cases allow individually tailored nutritional prescriptions to be designed for critically ill children. A multidisciplinary effort at the bedside is required to overcome barriers and deliver the prescribe nutrients to the critically ill child successfully. Nutrition support teams (NSTs), evidence- or consensus-based guidelines, and regular audits and improvements of practice parameters may facilitate this essential goal of critical care.

The prevalence of malnutrition in hospitalized patients is a significant health care problem because it influences patient outcomes.[1–5] Malnourished hospitalized patients have a higher rate of infectious and noninfectious complications, increased mortality, a longer length of hospital stay, and increased hospital costs.[5] In hospitalized children, malnutrition is associated with altered physiologic responses and increased resource use, and it influences outcome during critical illness.[6,7] The prevalence of malnutrition in children admitted to the pediatric intensive care unit (PICU) has remained unchanged over the past 3 decades.[8,9] Critical illness itself may increase metabolic demand on the host in the early stages of the stress response, and nutrient intake may be limited. Thus, children admitted to the PICU are at risk for worsening nutritional status and anthropometric changes with increased morbidity.[10]

Despite its high prevalence and consequences, medical awareness of malnutrition is lacking. Only a small number of hospitalized patients are assessed for nutritional

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status or referred for nutritional support.[11] Careful nutritional evaluation at admission to the PICU is essential for identification of children at risk for further nutritional deterioration and should allow interventions to optimize nutrient intake. The epidemiology and causes of malnutrition in critically ill children are described here, as are the importance of nutritional assessment of children in the PICU and measures to prevent their nutritional deterioration.

EPIDEMIOLOGY AND RISK FACTORS FOR MALNUTRITION IN THE PEDIATRIC INTENSIVE CARE UNIT

One in every five children admitted to the PICU experiences acute or chronic malnutrition.[3,8,9] Because of the lack of systematic nutritional assessment at many centers, the true extent of malnutrition in the PICU population may not be appreciated. Pediatric malnutrition, also commonly known as protein-energy malnutrition (PEM), remains a significant health care problem in the developing world and the industrial world. The correlation between nutritional status and outcomes is complex and probably bidirectional.[12] On the one hand, underlying disease state and the duration of pre-PICU illness may influence the severity of malnourishment and predispose some children to critical illness. Malnutrition in children is associated with physiologic alterations; micronutrient imbalance; gastrointestinal dysfunction; and impairment of cell-mediated immunity, phagocytic function, and the complement system. On the other hand, up to 44% of hospitalized children in a variety of disease states develop malnutrition during acute or chronic illness.[13,14] The increased energy demands secondary to the metabolic stress response to critical illness, erratic prescription of nutrients, and failure to administer adequate nutrients are factors responsible for the subsequent worsening of nutritional status in children admitted to the PICU. Indeed, acute and chronic malnutrition has been shown to worsen at discharge from the PICU.[8]

Infants have a high basal metabolic rate and limited energy reserves, and they are particularly at risk for developing nutritional deficiencies during illness. Some groups of critically ill children may be at an increased risk for developing malnutrition. Children with congenital heart disease (CHD) have a high incidence of PEM, which contributes to the poor outcome in this cohort.[15] Common reasons for energy deficits in children with CHD include decreased intake, increased energy expenditure (attributable to cardiac failure or increased work of breathing), and malabsorption (attributable to increased right-sided heart pressure, lower cardiac output, or altered gastrointestinal function).[16–19] In a retrospective review of newborns with hypoplastic left heart syndrome who underwent the traditional Norwood procedure, the authors have reported a high incidence of PEM manifested by low weight-for-age *z* scores.[20] After initial ICU hospitalization in the first month of life, weight-for-age *z* scores and weight-for-length *z* scores decreased over time, and half of the infants were severely underweight when readmitted for subsequent major cardiac surgery. Longer length of hospital or ICU stay and frequency of readmission were significantly correlated with poor nutritional status in this cohort, and aggressive enteral nutrition (EN) and parenteral nutrition (PN) were associated with better nutritional status.

Another group of critically ill children at nutritional risk includes those with burn injuries. In these children, a hypermetabolic stress response and poor intake result in energy deficits, and the negative effects on nutritional status may persist for months after injury. Decrease in lean body mass was shown for up to a year after the burn injury, with delayed linear growth reported for up to 2 years after burn injury.[21,22] Duration of PICU stay is an important factor associated with the development of cumulative