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Independent Review Article

Review of nutritional assessment and clinical outcomes in pediatric surgical patients: Does preoperative nutritional assessment impact clinical outcomes?

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ABSTRACT

Introduction: Malnourished adult patients who undergo surgical procedures tend to have worse clinical outcomes compared to well-nourished patients. In the pediatric surgical patient, nutritional assessment is considered a critical aspect of the initial evaluation, but a correlation between preoperative malnutrition and poor surgical outcomes is not clear. We hypothesized that an evidence-based review would reveal that measures of nutritional assessment in children would not correlate pre-operative malnutrition with poor surgical outcomes.
Materials and Methods: A search of major English language medical databases (Medline, Cochrane, SCOPUS) was conducted for the key words nutritional assessment, pediatric, children, surgery, and outcomes. All methods of nutritional assessment in pediatric surgery were evaluated for their relevance and relation to outcomes after surgery. The Oxford Center for Evidence Based Medicine (CEBM) classification for levels of evidence was used to develop grades of clinical recommendation for each variable studied.
Results: 35 articles were evaluated after an exhaustive literature search, of which six met inclusion criteria for this review. There is a paucity of high quality evidence correlating preoperative malnutrition in pediatric surgical patients with clinical outcomes. Factors contributing to the low level of evidence include a lack of high quality randomized controlled trials, a lack of consensus in study design and methods, and utilization of incongruous methods of nutritional assessment, including methods that may be unproven in the study population.
Conclusion: Larger multi center randomized studies are needed to offer higher level of evidence to support nutritional intervention prior to major elective pediatric surgery.

Malnourished adult patients who undergo surgical procedures tend to have worse clinical outcomes compared to well-nourished patients [1]. Preoperative malnutrition is associated with longer hospital length of stays, worse clinical condition, and increased healthcare related costs [2]. Numerous studies during the last 30 years have clearly demonstrated that malnutrition is a risk factor for postoperative complications in patients undergoing major abdominal surgery [3]. Preoperative nutritional assessment should theoretically help predict clinical outcomes, but it is problematic since some markers of malnutrition may be multifactorial in etiology, especially in the chronically ill patient.

In the pediatric surgical patient, nutritional assessment is considered a critical aspect of the initial evaluation, but a correlation between preoperative malnutrition and poor surgical outcomes is not clear. In 1981, Cooper demonstrated that there was a remarkably high prevalence of acute protein calorie malnutrition among hospitalized pediatric and pediatric surgical patients, but speculated as to whether perioperative nutritional support would influence morbidity and mortality [4]. Recent literature reinforces the concept that adequate nutritional support in critically ill children on mechanical ventilation improved 60-day mortality [5].

The metabolic response of the child or infant to operative stress is physiologically similar to the stress response in adults although it is altered in degree by the type of insult, its magnitude and duration, the metabolic reserve, and the capacity to mobilize reserves. In adults, major surgery or trauma causes a brief period of depressed metabolic rate followed by a phase of increased energy expenditure [6]. Adults also experience an increase in postoperative protein degradation, a negative nitrogen balance, and a decrease in muscle protein synthesis [6]. It seems that the energy requirements in children are modified minimally by operative stress alone [7,8]. Chronic or severe injurious insults, such as sepsis or severe burn injury, would alter the metabolic response in proportion to the duration and degree of injury [6,33]. In newborn infants, major abdominal surgery causes a moderate and immediate elevation of oxygen consumption and resting energy expenditure, but a rapid return to baseline after 12–24 h, with no further increase in energy expenditure in the first 5–7 days. The response in children and infants may be due to a diversion of energy

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from growth to repair of tissues and recovery [7,2]. However the latter statement must be tempered by the fact that post operative care strategies in this population such as mechanical ventilation (that decrease work of breathing), incubators (that reduce energy required to replace insensible energy losses), and use of sedation/opiates (that reduce activity associated daily energy requirements) significantly reduce energy requirements and may be responsible for the lower energy expenditure noted.

Several barriers exist to evaluating the effect of preoperative malnutrition on surgical outcomes in infants and children. This includes a lack of consensus for nutrition assessment techniques, and a paucity of high quality, randomized, controlled trials correlating a statistically significant relationship between preoperative malnutrition and outcomes. We hypothesized that an evidence-based review would reveal that measures of nutritional assessment in children would not correlate pre-operative malnutrition with poor surgical outcomes.

1. Materials and methods

A search of major English language medical databases (PUBMED, MEDLINE, Cochrane) was conducted for articles that preoperatively assessed the nutritional status of pediatric surgical patients and correlated them with clinical outcomes. Key words included nutritional assessment, malnutrition, preoperative assessment, pediatric, children, surgery, and outcomes. The only filters set were for age group, which included children from newborn to 18 years of age. All articles including randomized controlled trials (RCT), cohort studies, case–control studies, case reports, literature reviews, and meta-analyses were considered. These articles were critically evaluated to determine the level of evidence.

To meet inclusion criteria, the article must have measured the nutritional status of the patient in the preoperative period, by any means, and correlated that data with clinical outcomes in the perioperative period (Table 1). Articles were excluded if they contained adult data, did not measure nutritional parameters preoperatively, were informative articles without new data, did not isolate data for surgical patients, did not include clinical outcomes data, or focused only on metabolic or biochemical changes in the post-operative period.

The Oxford Center for Evidence Based Medicine (CEBM) classification for levels of evidence was used to develop grades of clinical recommendation for each variable studied and its rationale addressed in the 'review of scientific evidence' that follows a brief summary of each article reviewed (Table 2). A grade A recommendation was used for consistent level 1 studies, Grade B for consistent level 2 or 3 studies or extrapolations from level 1 studies, Grade C for level 4 studies or extrapolations from level 2 or 3 studies, and Grade D representing level 5 evidence or inconclusive studies of any level. Only studies involving pediatric surgical patients were reviewed.

2. Results

35 articles were evaluated in detail after an exhaustive literature search, of which six [10,12,13,22,23,25,29] met inclusion criteria for this review. Three articles were retrospective chart reviews [22,25,29], two articles were prospective controlled cohort studies [10,12], and one article was a 2-center cohort study [13]. The two-center prospective study took place in California and Guatemala [13], while the other two prospective studies were conducted in Canada [12] and Brazil [10]. The retrospective studies were conducted in the USA [29], Japan [25], and Mexico [22].

2.1. Patient demographics

The prospective study by Secker et al. [12] utilized a heterogeneous cohort of pediatric general and non-cardiac thoracic surgery patients of various ages, from 31 days to 17.9 years of age, undergoing surgery on a non-emergent basis [12].

Five articles [10,13,22,25,26] meeting inclusion criteria studied infants and toddlers undergoing surgical repair of congenital heart defects (Table 1).

2.2. Clinical outcome measures

The clinical outcome measures among the five articles studying infants undergoing congenital heart defect repair were similar [10,13,22,25,29]. They favored measures of mortality, hospital and ICU length of stay, and duration of mechanical ventilation in relation to the nutritional status of the patient at the time of operation (Table 2).

The article by Secker et al. [12] measured nutrition associated complications and classified them as major or minor. These included unplanned reoperation, readmission, infectious and non-infectious complications, and non-prophylactic use of antibiotics, in addition to hospital length of stay. Patients were followed for 30 days postoperatively for nutrition-associated complications [12].

2.3. Modalities of nutritional assessment

2.3.1. Overview

Numerous options are available to assess the nutritional status of pediatric surgical patients, broadly classified into objective and subjective modalities. There are two general classes of objective assessment (1), anthropometric measurements of body composition and (2) measurement of serum protein levels. Subjective assessments include questionnaires, which incorporate both subjective data from the patient history, and anthropometric body composition measurements. These include the Subjective Global Nutritional Assessment (SGNA), utilized by Secker et al. [12] and the Mini Nutrition Assessment (MNA), which was not utilized in the reviewed articles and thus will not be further discussed. Both general classes of nutritional assessment are subject to observer error or are influenced by changes in body composition induced by non-nutritional factors [9].

2.3.2. Anthropometric nutritional assessment modalities

2.3.2.1. Background. Anthropometric assessment of nutritional status is an objective assessment tool involving measurement of body dimensions and composition to evaluate nutritional status and growth. The most basic are age, height, weight, and head circumference. This is a common and inexpensive method to assess growth and nutritional status, which can also be charted on a standardized growth curve for comparison with normative data. Other measurements can also be utilized, such as skin fold thickness, mid-arm circumference, and handgrip strength. Once patients are over 2 years of age, weight to length ratio can best be reflected using body mass index (BMI), or expression of BMI as a Z-score [14,20,21].

Waterlow's criterion is an objective method of assessing the patient for both acute and chronic malnutrition. Weight for height as an indicator of the present state of nutrition (stunting), and height for age as an indicator of past nutrition (wasting) [30,31]. Acute changes in nutritional status should have a more immediate effect on weight than length or height, and chronic malnutrition usually impacts both the height and weight of the child [14,21].

2.3.2.2. Review of scientific evidence. There was a statistically significant correlation between anthropometric measures of nutritional assessment and clinical outcomes in four articles included in this review (Table 1). The anthropometric modalities that each of the authors found to be significant were incongruent, as was the statistically significant nutrition associated clinical outcome. There