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Safety and efficacy of uninterrupted perioperative enteral feeding in pediatric burn patients

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ABSTRACT

Introduction: Burn injuries are a significant cause of morbidity. Early enteral nutrition has been shown to improve outcomes, however enteral nutrition is often held for procedures receiving general anesthesia. Limited data is available on uninterrupted perioperative nutrition in pediatric burn patients.

Methods: A single, American Burn Association verified burn center database was queried for patients ≤18 years of age with ≥15% total body surface area (TBSA) burn injuries who underwent surgeries with general anesthesia. Demographic and clinical details were analyzed comparing patients who were fed continuously and those with interrupted feeds.

Results: Thirty-one patients met inclusion criteria. Eighteen had continuous feeds and thirteen had interrupted feeds. We found perioperative enteral feeds safe as there were no aspiration events in these patients. Patients with interrupted feeds lost an average of 119.1 kcal/kg and 1.4 days of estimated energy needs. This was a 125% fall below metabolic needs. This loss was more pronounced with multiple operations and for patients <30 kg. Patients with continuous feeds gained an average of 144.4 kcal/kg and 1.7 days of estimated energy needs. These patients surpassed metabolic needs by 173%. Again, this had the biggest impact in patients with multiple operations and those <30 kg.

Conclusions: The metabolic demands of burn patients are above most critically ill patients. To meet these demands, we implemented uninterrupted perioperative feeding. There were no aspiration events. Continuous feeds were an effective means to achieve caloric demands and moderate catabolic injury. We demonstrated safety and efficacy of uninterrupted perioperative feeding of pediatric burn patients.

1. Introduction

Patients who suffer from extensive burn injury will often undergo multiple operative procedures. The cost of their care as well as their morbidity and mortality increase as the percentage of total body surface area (TBSA) involved increases [1]. Operations for burn wound management are frequently performed under general anesthesia, which is even more common in pediatric patients. Historically, the use of general anesthesia requires patient's to be nil per os (NPO) at midnight of the intended procedure day.

With the use of general anesthesia, perioperative interruption of enteral nutrition can lead to a major void in a burn patient's caloric support. After injury, burn patients are in a

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hypermetabolic state as evidenced by negative nitrogen balance and thus, nutritional support is critical [2]. It has been estimated that burn patients benefit from up to 150–200% of basal energy needs [3,4]. Moreover, the pediatric population while in demand of energy for physiologic growth has baseline lower physiologic nutrient stores making these patients highly susceptible to caloric loss [3].

Over the last ten years, there has been growing evidence demonstrating that early nutrition in pediatric burn patients is safe, efficacious and leads to better outcomes [5–7]. Ideally, this time period begins in the first 24 h after injury and specifically within a matter of hours after admission to the hospital [8,9]. Early enteral feeding in burn injuries is now a recommendation of large societies such as the American Burn Association [8,10], and has shown considerable buy-in and compliance from practitioners [11].

While there is increasing emphasis on early feeds, there is limited data on clinical experience with uninterrupted perioperative enteral feeding in pediatric burn patients. One key study by Jenkins et al. compared forty patients continuously fed through operations to forty patients who had enteral nutrition withheld before, during and immediately after the operations. The fed group had an average of 3.6 operations per patient compared to 2.3 for the unfed group. They found a statistically significant disadvantage to unfed patients with consistent caloric deficits through the study, higher supplemental albumin needs and higher number of wound infections; interestingly, the continuously fed group received significantly more antibiotic therapy [12].

Still, uninterrupted feeding is not widely practiced nor accepted at this time. Given the limited experience, especially in pediatrics, our center sought to supplement this void and hypothesized that continuation of perioperative feeds is safe and will lead to more calories gained as opposed to those without perioperative feeds. We implemented a protocol that allows ongoing post-pyloric feeding while patients undergo procedures requiring general anesthesia. The purpose of this study was to analyze the safety, but also the efficacy of uninterrupted perioperative enteral feeding in pediatric burn patients.

2. Methods

Using our American Burn Association verified burn center database, we retrospectively identified all patients ≤18 years of age, with ≥15% total body surface area (TBSA) burn from February 2012 to February 2016. Patients who underwent surgery with general anesthesia along with supplemental nutrition were further stratified into the study. We focused our comparison between two groups: those that were continuously fed and those with interrupted feeds. The two cohorts were specifically determined by the time frame mentioned above. At our institution, prior to 2013, patients were not uniformly fed based on TBSA as this was not yet a universal protocol. After the implementation of the protocol, patients were fed based on severity of >15%. This contrast opportunely distinguished the fed and interrupted cohorts.

The primary outcome of interest was to determine the safety of perioperative feeds. The secondary outcome of interest was to assess the nutritional variance between the two groups.

A total of 31 patients met criteria from those listed above and their medical charts including anesthetic records were reviewed extensively. Records were reviewed for the following: (1) demographic data including age, weight (kilograms), gender and TBSA, (2) mechanism of injury, (3) number of operative procedures and (4) length of stay. Interrupted feeds were defined when all enteral nutrition was held prior to operation(s). Feeds were held, at minimum, eight hours from planned preoperative time. All of these holds were not exclusively at midnight, as some planned or semi-elective operation start times were mid to late-day and feed holds could be planned on a more time-sensitive basis. The duration without supplemental feeds for each patient were then calculated on the length of time until feeds were restarted after the procedure.

Perioperative feeds were administered via a nasoenteric feeding tube that was confirmed to be post-pyloric on imaging. Safety of perioperative feeds was determined by the incidence of aspiration. This was determined by examination of the anesthetic record, any diagnosis of aspiration pneumonia, along with any need for supplemental oxygen after discharge from the post anesthesia recovery unit. Supplemental oxygen was used as an indicator of aspiration as hypoxia is sensitive sign of pneumonia or pneumonitis. While there is no standard definition for aspiration pneumonia in pediatric literature, we used the WHO definition of pneumonia in childhood as a guide. A diagnosis of pneumonia in this definition includes cough or difficulty breathing and at least one additional indicator, one of which includes oxygen saturation <90% on pulse oximetry [13].

The details of the two cohorts' nutritional supplementation was first determined by calculation of each patient's individual Estimated Energy Needs (EEN), expressed in kilocalories. Our standard protocol for this calculation used the Schofield equation for resting energy expenditure. The Schofield equation uses height, weight, age and a stress factor for burn injury, which ranges from 1.3 to 2 to account for the hypermetabolic state of burn patients [14]. Based on the calculated EEN, we calculated the days of nutrition gained or lost as a result of having or not having perioperative enteral feeds by simple division of kilocalories lost/gained by daily EEN. We defined kilocalories lost as the amount of kilocalories the patient would have received had they been fed after midnight and throughout the operating room procedure. Total kilocalories gained were determined by the kilocalories the patient received as a result of uninterrupted perioperative feeds in leading up to and during the procedures. Furthermore, we divided the kilocalories gained and lost per kilogram body weight of the patient. Data are expressed in terms of kilocalories per kilogram body weight as this is historically how energy needs in children are calculated [15] and similar to medications, dietary requirements should be administered based on the differences that come with developing body composition and physiology (distribution, absorption and pharmacokinetics) as children age [16]. Oral intake separate from enteral supplementation was not regulated with the exception of the restriction of patient-directed oral intake the midnight before the procedure; the group with interrupted

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