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A pilot review of gradual versus goal re-initiation of enteral nutrition after burn surgery in the hemodynamically stable patient

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ABSTRACT

Severe weight loss resulting from inadequate nutritional intake along with the hypermetabolism after thermal injury can result in impaired immune function and delayed wound healing. This observational study was conducted on adults admitted between October 2007 and April 2012 with at least 20% total body surface area burn requiring excision who previously tolerated gastric enteral nutrition at calorie goal and who returned from surgery hemodynamically stable (no new pressor requirement) and compared the effect of goal rate re-initiation versus slow re-initiation after the first excision and grafting. Demographic, intake, and tolerance data were collected during the 36 h following surgery and were analyzed with descriptive and comparative statistics. Data were collected on 14 subjects who met the inclusion criteria. Subjects in the goal rate re-initiation group ($n = 7$) met a significantly greater percentage of caloric goals ($99 \pm 12\%$ versus $58 \pm 21\%$, $p = 0.003$) during the 36 h following surgery than subjects in the slow re-initiation group ($n = 7$). There were no incidences of emesis, aspiration, or ischemic bowel in either group. The goal rate re-initiation group had a 29% incidence of either stool output >1 L ($n = 1$) or gastric residual volumes >500 mL ($n = 1$), whereas these were not present in the slow re-initiation group ($p = 0.462$). In conclusion, in this small pilot study, we found that enteral nutrition could be re-initiated after the first excision and grafting in those patients who previously tolerated gastric enteral nutrition meeting caloric goals who return from surgery hemodynamically stable without a significant difference in intolerance and with a significantly higher percentage of calorie goals achieved, but larger studies are required.

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1. Introduction

Thermal injuries result in increased energy expenditure, catabolism, and loss of lean body mass [1–3]. Basal metabolic rates may double [4–6], and severe weight loss resulting from inadequate nutritional intake along with this hypermetabolic, catabolic state can result in impaired antibacterial host defenses and delayed wound healing [1,2]. Multiple studies have shown that early post-burn feeding results in increased

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provision of protein and calories; and improved outcomes include increased wound healing rates, decreased wasting, reduced length of stay (LOS), and reduced mortality [1,7–11]. To achieve the benefits of enteral nutrition (EN), the American Society for Parenteral and Enteral Nutrition (ASPEN) and the Society of Critical Care Medicine (SCCM) recommend in their guidelines that EN be initiated within the first 24–48 h following admission and advanced to the goal rate over the next 48–72 h to provide greater than 50–65% of goal calories in the first week of hospitalization [6]. A retrospective review associated with the Glue Grant published in the *Journal of Burn Care and Research* in 2011 found that burn patients who had EN initiated within 24 h of admission had a shorter intensive care unit LOS and decreased incidences of wound infections ($p = 0.030$ and $p = 0.010$) [11]. Although the ASPEN/SCCM guidelines address timing for both initiation and achievement of goal rate for EN and the Glue Grant provides evidence for early initiation, there is insufficient evidence to support more specific recommendations on the rate of delivery at initiation [6]. Once a patient is considered hemodynamically stable (HDS), common practice is to slowly initiate and advance EN while monitoring for signs of feeding intolerance such as vomiting, diarrhea, abdominal distension, and gastric residual volumes (GRVs). The practice of slowly initiating EN is also often used with re-initiation of EN following interruptions for surgical procedures. This practice is not supported by evidence-based research.

A prospective, randomized study by Desachy et al. in 2008 compared two early EN protocols in which EN goal rate was introduced either immediately or gradually [12]. This study showed that there was significant improvement in the amount of calories delivered with no difference in serious adverse events between groups. However, the group that received the EN goal rate immediately had GRVs greater than 300 mL more frequently than the group receiving calories gradually ($p = 0.04$). Although GRVs over 300 mL may have been described as elevated in the past, the ASPEN/SCCM guidelines recommend not holding EN for GRVs less than 500 mL [6]. Desachy's study examined the initiation of EN, not the re-initiation of EN after surgery.

The practice of goal rate initiation, and specifically goal rate *re*-initiation (GRR) (after a goal rate has been achieved previously), has not been thoroughly studied. Our facility has closely examined caloric deficits and over time has decreased these deficits. One method of decreasing these calorie deficits was to re-initiate EN at the previously achieved goal rate when the patient returns from surgery HDS.

The purpose of this study was to examine our change in practice and to compare the effect of the GRR of EN versus slow re-initiation (SR) in HDS post-surgical burn patients on caloric provision, incidence of gastrointestinal (GI) complications, GRVs, and outcomes. We hypothesized that subjects in the GRR group would have improved caloric delivery and that there would be no difference between groups with feeding tolerance.

2. Methods

This retrospective review of a prospective, descriptive study included subjects who were 18 years or older, had a total body surface area (TBSA) burn greater than or equal to 20%, and were admitted between October 1, 2007 and April 1, 2012. Subjects were excluded from this analysis if the EN calorie goal to achieve resting energy expenditure along with an activity factor of 1.2 was not achieved prior to the first surgical excision and grafting (E&G) (including instances where parenteral nutrition was used rather than EN or the subject consumed food orally). Because the change in clinical practice included only restarting at the previously tolerated goal for EN if the patient returned from surgery HDS, we excluded any subjects who had a new pressor requirement between return from surgery and initiation of EN. Only subjects who were being fed in the stomach (not post-pyloric) were included because this was the case for the majority of the subjects. This study was approved by the local Institutional Review Board.

Clinically, the standard of care included placing a naso-gastric feeding tube on the day of admission for all patients with burns exceeding 30% TBSA as well as those who were suspected to be unable to meet calorie goals through oral intake. Post-pyloric feeding tubes were placed on a case-by-case basis at the physician's discretion. EN was initiated at 20 mL/h and then increased by 20 mL/h every 4 h as tolerated until the goal rate was reached. The Carlson and Milner equations were used to predict calorie expenditure [13,14]. The Milner equation was created for >30 days after injury, with the factor of number of days post burn added to the Carlson equation using linear regression [14]. We recently found the Carlson and Milner equations to be the most accurate in predicting resting energy expenditure, with the Milner equation having the lowest mean error [15]. Metabolic cart (VMAX Encore) study results, when they were able to be obtained, replaced predictive equation results to estimate calorie goals. Activity factors of 1.2–1.4 were used because these factors have been shown to maximize the retention of lean body mass and maintain weight, respectively [16]. High-protein, high-carbohydrate, low-fat modular EN (0.94 or 1.5 kcal/mL) was provided because it has been shown to improve the net balance of skeletal muscle protein in burn patients [17]. EN was discontinued 4 h prior to surgery. The registered dietitian (RD) encouraged the minimization of time EN was held for procedures and advocated for GRR after surgery when the patient returned from surgery HDS. Upon return from surgery, EN was re-initiated at a rate lower than the previously tolerated goal rate and increased as tolerated until the goal rate was reached (SR group), or EN was re-initiated at the previously achieved goal rate (GRR group). The differences in these practices were largely due to new residents and/or nursing staff.

GRVs were monitored every 4 h. When GRVs were greater than 500 mL with EN appearance, EN was held and the physician was notified. EN continued if GRVs were greater than 300 mL and less than or equal to 500 mL, and GRVs were rechecked in 2 h. If after 2 h the GRVs remained greater than 300 mL with EN appearance, the EN was held and the physician was notified. Treatment for elevated GRVs included gastric motility agents and/or post-pyloric feeding tube placement. Residuals were returned up to a maximum of 300 mL.

The following demographic, clinical, and outcome data were collected from the subject's electronic medical record: age, gender, admission date, injury date, days from injury to