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Factors affecting the caloric and protein intake over time in critically ill trauma patients

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ABSTRACT

Background: Major trauma leads to increased nutritional requirements. However, little is known about the actual amount of calories and protein administered and the factors affecting the intake over time in critically ill trauma patients.

Methods: Prospective study including 100 trauma patients admitted to the Los Angeles County + University of Southern California Medical Center intensive care unit between March 2014 and October 2014. Inclusion criteria were age > 16 y, surgery at admission, and no oral nutrition. The caloric and protein intake was recorded, and requirements were calculated daily for 28 d. The nutritional intake and the impact of clinical factors on the intake over time were assessed using mixed model analysis.

Results: The caloric and protein intake significantly increased over time, but the median intake did not meet the median calculated requirements at any time. Multivariable analysis revealed a smaller increase of the nutritional intake over time in patients with an injury severity score > 45, whereas penetrating injury and laparotomy were associated with a higher increase of the intake. Body mass index scores ≥ 30 kg/m^2, traumatic brain injury, and gastrointestinal tract injuries were associated with a smaller increase of the caloric intake over time.

Conclusions: The median nutritional intake did not meet the median calculated requirements over time. A smaller increase of the nutritional intake over time was found in patients with a higher injury burden, whereas penetrating injury and laparotomy were associated with a higher increase of the intake. Higher body mass index scores, traumatic brain injury, and gastrointestinal tract injuries were associated with a smaller increase of the caloric intake over time. These clinical factors can help to adjust the nutritional support in critically ill trauma patients.

Parts of the results have been presented at the 16th European Congress of Trauma and Emergency Surgery (ECTES), May 10-12, 2015, Amsterdam, the Netherlands, and the 5th Swiss Trauma and Resuscitation Day, March 17, 2016, Bern, Switzerland.

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Introduction

Major trauma and critical illness are associated with important metabolic changes throughout the acute treatment and recovery phases. Both the total body fat content and total body protein have been shown to decrease over time in critically ill patients.[1,2] Protein losses are reported to be as high as 14% of the total body protein stores in the first 3 wk after trauma.[2] Depending on the severity of the initial injury and the surgical procedures required, a hypermetabolic and catabolic state persists for weeks after the trauma.[1,3,4] Consequently, both caloric and protein requirements are increased after major trauma.[3,5,6]

Adding to this problem, significant nutrition deficits, due to insufficient caloric and protein intake, have been reported in critically ill patients, including trauma victims.[7-9] These caloric and protein deficits have been shown to be associated with significantly worse outcomes, including infectious complications,[10-12] prolonged hospital length of stay (LOS),[13] prolonged mechanical ventilation,[12] and increased mortality.[13-16]

At the other end of the spectrum, overfeeding has also been reported to be associated with increased complications, including liver dysfunction, hyperglycemia, azotemia, more infectious complications, and higher mortality.[17-22]

Newer studies have suggested a positive effect of permissive underfeeding on outcomes in patients requiring enteral or parenteral nutrition.[23-25] In a recent randomized multicenter trial investigating the effect of permissive underfeeding on outcomes in critically ill patients, acquired infections in the intensive care unit (ICU), the ICU and hospital LOS, and the 90-d mortality rate were not significantly different in the permissive underfeeding and standard enteral feeding group.[26]

Although increased caloric and protein requirements are well described in critically ill trauma patients, underfeeding and overfeeding have been shown to be associated with worse outcomes, and little is known about the actual caloric and protein intake over time, as well as the factors affecting the caloric and protein intake in this patient population. The aim of this prospective observational study was, therefore, to assess the caloric and protein intake and the factors that affect the intake over time in critically ill trauma patients.

Patients and methods

This study was approved by the Institutional Review Board of the University of Southern California (USC). A waiver for informed consent was obtained from the same.

Patient selection

This is a prospective observational study including all consecutive trauma patients (age $\geq$ 16 y) from February through November 2014 who underwent surgery for trauma, were admitted to the surgical ICU of the Los Angeles County + USC Medical Center, and did not receive oral nutrition at ICU admission. The Los Angeles County + USC Medical Center is an American College of Surgeons–verified level I trauma center with an yearly admission of 5000 patients.

Data collection

Included patients were observed for 28 d or until oral nutrition was resumed. Data collection included patient characteristics (sex, age, weight, body mass index [BMI], ideal body weight [IBW]), mechanism of injury (blunt *versus* penetrating), injury severity (abbreviated injury scale, injury severity score [ISS]), injury characteristics (gastrointestinal tract [GIT] injury, traumatic brain injury [TBI]), surgical procedures (number of procedures performed, laparotomy, thoracotomy), daily calculated caloric and protein requirements, daily administered calories and protein, and daily recorded vital signs.

Nutritional intake

Daily caloric and protein intake was recorded from all sources including total parenteral nutrition (TPN), enteral nutrition, Ringer's lactate solutions (Baxter Healthcare, Deerfield, IL), 5% and 10% glucose solutions, propofol infusions, albumin solutions, and enteral protein supplements. The following solutions were used for enteral nutrition: Beneprotein (Nestle HealthCare Nutrition, Bridgewater, NJ), Nepro HP (Abbott Nutrition, Lake Forest, IL), Peptamen (Nestle HealthCare Nutrition, Bridgewater, NJ), Promote (Abbott Nutrition, Lake Forest, IL), Pulmocare (Abbott Nutrition, Lake Forest, IL), and Renalcal (Nestle HealthCare Nutrition, Bridgewater, NJ). For TPN, three solutions were administered: TPN standard lipid (dextrose 5%, amino acids 3%, lipids 5%), TPN standard (dextrose 5%, amino acids 4.45%), and TPN low protein (dextrose 4.67%, amino acids 2.8%). As stated in the European Society for Clinical Nutrition and Metabolism guidelines,[27,28] enteral or parenteral nutrition was started in patients who were not expected to be on normal nutrition within 3 d and who had no contraindication for enteral or parenteral nutrition, such as hemodynamic instability, surgical interventions, or ileus.

Calculated caloric and protein requirements

Caloric requirements were calculated daily using the Harris–Benedict (HB) equation[29-32] for all patients and the Penn State (PS) equation[33-35] for mechanically ventilated patients. For the HB equation, an activity factor of 1.2 (confined to bed) and an injury factor of 1.6 (if a systemic inflammatory response syndrome was present) were used. Systemic inflammatory response syndrome was defined according to the American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference guidelines.[36] The variables required for both the HB and PS equations were recorded daily.

Protein requirements were calculated daily according to the European Society for Clinical Nutrition and Metabolism guidelines for ICU patients.[27] Both the lower (1.2 g protein per kg of IBW per day) and the higher estimates (1.5 g protein per kg of IBW per day) were calculated. The IBW was calculated using the Devine's formula.[37]