Clinical Nutrition xxx (2016) 1–8

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

Original article

Energy and protein deficits throughout hospitalization in patients admitted with a traumatic brain injury

Lee-anne S. Chapple [a, b, *], Adam M. Deane [a, b, c, 1], Daren K. Heyland [d], Kylie Lange [e], Amelia J. Kranz [a, 2], Lauren T. Williams [f, 3], Marianne J. Chapman [a, b, c, 4]

[a] Discipline of Acute Care Medicine, University of Adelaide, North Terrace, Adelaide, South Australia, Australia
[b] National Health and Medical Research Council of Australia Centre for Clinical Research Excellence in Nutritional Physiology and Outcomes, Level 6, Eleanor Harrald Building, North Terrace, Adelaide, South Australia, Australia
[c] Intensive Care Unit, Level 4, Emergency Services Building, Royal Adelaide Hospital, North Terrace, Adelaide, South Australia, Australia
[d] Clinical Evaluation Research Unit, Kingston General Hospital, Kingston, Ontario, Canada
[e] Discipline of Medicine, University of Adelaide, North Terrace, Adelaide, South Australia, Australia
[f] Menzies Health Institute of Queensland, Griffith University, Queensland, Australia

ARTICLE INFO

Article history:
Received 14 December 2015
Accepted 10 February 2016

Keywords:
Nutrition
Oral intake
Critical care
Head injury
Traumatic brain injury

SUMMARY

Background and aims: Patients with traumatic brain injury (TBI) experience considerable energy and protein deficits in the intensive care unit (ICU) and these are associated with adverse outcomes. However, nutrition delivery after ICU discharge during ward-based care, particularly from oral diet, has not been measured. This study aimed to quantify energy and protein delivery and deficits over the entire hospitalization for critically ill TBI patients.

Methods: Consecutively admitted adult patients with a moderate-severe TBI (Glasgow Coma Scale 3–12) over 12 months were eligible. Observational data on energy and protein delivered from all routes were collected until hospital discharge or day 90 and compared to dietician prescriptions. Oral intake was quantified using weighed food records on three pre-specified days each week. Data are mean (SD) unless indicated. Cumulative deficit is the mean absolute difference between intake and estimated requirements.

Results: Thirty-seven patients [45.3 (15.8) years; 87% male; median APACHE II 18 (IQR: 14–22)] were studied for 1512 days. Median duration of ICU and ward-based stay was 13.4 (IQR: 6.4–17.9) and 19.9 (9.6–32.0) days, respectively. Over the entire hospitalization patients had a cumulative deficit of 18,242 (16,642) kcal and 1315 (1028) g protein. Energy and protein intakes were less in ICU than the ward (1798 (800) vs 1980 (915) kcal/day, $p = 0.015$; 79 (47) vs 89 (41) g/day protein, $p = 0.001$). Energy deficits were almost two-fold greater in patients exclusively receiving nutrition orally than tube-fed (806 (616) vs 445 (567) kcal/day, $p = 0.016$) while protein deficits were similar (40 (5) vs 37 (6) g/day, $p = 0.616$). Primary reasons for interruptions to enteral and oral nutrition were fasting for surgery/procedures and patient-related reasons, respectively.

Conclusions: Patients admitted to ICU with a TBI have energy and protein deficits that persist after ICU discharge, leading to considerable shortfalls over the entire hospitalization. Patients ingesting nutrition orally are at particular risk of energy deficit.

* Corresponding author. Discipline of Acute Care Medicine, University of Adelaide, North Terrace, Adelaide, South Australia, Australia. Tel.: +61 8 8222 4624; fax: +61 8 8223 3870.

E-mail addresses: lee-anne.costello@adelaide.edu.au (L.S. Chapple), adam.m.deane@gmail.com (A.M. Deane), dkh2@queensu.ca (D.K. Heyland), kylie.lange@adelaide.edu.au (K. Lange), amelia-jk@hotmail.com (A.J. Kranz), lauren.williams@griffith.edu.au (L.T. Williams), Marianne.chapman@health.sa.gov.au (M.J. Chapman).

[1] Tel.: +61 8 8222 4624, +61 431 967 560 (mobile).
[2] Tel.: +61 8 8222 4624; fax: +61 8 8223 3870.
[3] Tel.: +61 7 5678 0155.
[4] Tel.: +61 412 183 894 (mobile).

http://dx.doi.org/10.1016/j.clnu.2016.02.009
0261-5614/

Abbreviations

APACHE II	Acute Physiology and Chronic Health Evaluation II
DAI	Diffuse Axonal Injury
BMI	Body Mass Index
EN	Enteral Nutrition
GCS	Glasgow Coma Scale
ICU	Intensive Care Unit
SD	Standard Deviation
SOFA	Sequential Organ Failure Assessment
TBI	Traumatic Brain Injury

1. Introduction

Traumatic brain injury (TBI) acutely increases metabolic rate and protein catabolism [1]. Observational data consistently show that during the initial phase after moderate or severe TBI, when patients are in the intensive care unit (ICU), they are substantially underfed, similar to critically ill patients admitted with other diagnoses [2–4]. Energy and protein deficits are associated with worse outcomes, both for ICU patients with TBI and other conditions [2,5,6].

Confusion, delirium, fasting for repeated procedures and swallowing difficulties are all prevalent in patients after a TBI and are risk factors for persistent energy and protein deficits [7–10]. Furthermore, in patients with TBI these energy and protein shortfalls can result in malnutrition which is associated with adverse outcomes such as longer duration of admission to rehabilitation facilities and unfavorable neurological outcome at six months [11,12]. Conversely, critically ill patients achieving energy requirements early during ICU admission have better self-reported physical function six months after ICU discharge [13]. Given patients recovering from a TBI typically have prolonged periods of recovery, nutritional strategies that facilitate rehabilitation are likely to be of benefit [14].

There is a paucity of research on the provision of nutrition support in survivors of critical illness [15]. Few studies have precisely quantified energy and protein deficits from oral intake in the critically ill [16]. Moreover, relatively little information is available as to the provision of energy and protein to patients throughout the entire hospitalization including both ICU and ward-based care [17]. Finally, the few studies in hospitalized patients that do measure oral intake use methods that either rely on reporting capabilities of the patient, estimate consumed intake, or do not account for individual food items with varying nutritional compositions. The use of investigator-led weighed food records provides accurate and detailed data regarding energy and protein intake and is considered the gold-standard in free-living individuals [18], yet has not been previously reported in the literature for hospitalized patients.

The primary objective of this study was to precisely quantify the amount of energy and protein prescribed and delivered throughout hospitalization to patients initially admitted to ICU with a moderate-severe TBI. The secondary objective was to describe barriers that exist to achieving nutrient targets in TBI patients.

2. Materials and methods

2.1. Study design and population

A prospective observational study was conducted at a single university-affiliated hospital that is the major acute neuro-trauma referral center for the state of South Australia. All patients admitted throughout a 12-month period (June 2014–May 2015) were eligible to participate in this study if they: had a moderate or severe TBI (Glasgow Coma Scale 9–12 or 3–8 respectively); were ≥18 years of age; and were in ICU for ≥48 h. Patients were excluded if they were expected to die imminently. For patients who were deemed incompetent to provide consent, the patient's legally authorized representative was approached. The protocol was approved by the Royal Adelaide Hospital Human Research Ethics Committee (HREC/14/RAH/100).

2.2. Data collection

Demographic information was collected including cause of injury, brain injury classification using the International Classification of Disease-10, and post-hospital discharge location. Acute Physiology and Chronic Health Evaluation II (APACHE II) and Trauma Injury Severity Scores (TRISS) were collected from the first day of ICU admission to assess the severity of illness. The Nutrition Risk in the Critically ill (NUTRIC) score [19] was calculated to determine those patients that were more likely to benefit from aggressive nutrition therapy. A score of 0–4 indicates a low malnutrition risk, while a score of 5–9 represents a high malnutrition risk associated with worse clinical outcomes. Data were collected up until hospital discharge or, for those remaining in hospital, censored at 90 days from hospital admission. Data collected on the day of transfer from ICU to the ward were categorized as ICU data.

2.3. Dietary assessment

Data on nutrition delivered from all routes were collected by two trained dieticians. Information regarding nutrition provided via the enteral and parenteral routes was collected from fluid balance and intravenous fluid charts completed as routine care by nursing staff, and the amount of total energy and protein delivered was calculated. To precisely quantify nutrient consumed orally, investigator-led weighed food records were conducted on three pre-determined days: two days between Monday and Friday and one day on the weekend. All food and fluids provided from breakfast to one hour post-dinner were included and data extrapolated to provide a weekly average. Individual meal components were weighed by the two dietetic investigators using Salter Brecknell Model 405 digital scales (Australia) both prior to delivery to the patient, and after consumption to measure waste and calculate the total proportion consumed. Items provided outside of observation times were estimated using collection of wrappers, nursing notes, and communication with patients, family, and nursing staff. Where actual amounts could not be weighed, estimates using standardized serving sizes were used. When meal trays were collected before plate waste could be weighed, it was assumed that half of the items provided were consumed. Recorded weights for each item were entered into FoodWorks 8 dietary analysis software (Australia) to calculate energy and protein intakes. The provision of therapeutic diets (e.g. smooth pureed diet) and dietician prescriptions were assessed from review of meal tickets, catering software and case note documentation.

Data from weighed food records and nutritional requirements were extrapolated to represent daily intake data. Nutritional intake and estimated requirements from ICU admission and hospital discharge day were extrapolated to a 24 h period to enable comparison with full data days.

Please cite this article in press as: Chapple L-aS, et al., Energy and protein deficits throughout hospitalization in patients admitted with a traumatic brain injury, Clinical Nutrition (2016), http://dx.doi.org/10.1016/j.clnu.2016.02.009