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International observational study of nutritional support in mechanically ventilated patients following burn injury

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ABSTRACT

Introduction: It has been proposed that nutritional therapy in critically ill patients after major burn reduces mortality. However, the actual practice of nutrient delivery, and the effect on outcome, has not been described.
Study objectives: To evaluate international practices related to nutritional support and outcomes in mechanically ventilated patients with burn injury.
Methods: Data from the International Nutrition Surveys (2007–2011) for patients with a primary diagnosis of burn were extracted and analysed.
Results: Eighty-eight of 90 patients (aged 16–84 years) received enteral nutrition. The median time for initiation of enteral feeding was 17 h [range 0–65]. Fifty patients (57%) had interruptions to nutrient delivery, most often these interruptions were fasting for operative procedures. There were substantive energy and protein deficits [943 (654) kcal/day and 49 (41) g/day, respectively; mean (SD)]. Nineteen (21%) patients died within 60 days of admission, and the energy and protein deficits were greater in those that died compared with survivors [died vs. survived, energy: 1251 (742) vs. 861 (607) kcal/d; $p = 0.02$; and protein 67(42) vs. 44(39) g/d; $p = 0.03$]. Energy and protein deficits were associated with increased mortality with the greater the deficit, the stronger the association with death (odds ratio for death: energy deficit/100 kcal 1.10 (1.01, 1.19); $p = 0.028$ and protein/10 g 1.16 (1.01, 1.33); $p = 0.037$). Results were similar and remained significant after adjusting for severity of illness.
Conclusions: Mechanically ventilated patients following burn develop substantial energy and protein deficits, with lesser deficits observed in survivors.

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1. Introduction

Major burns increase basal metabolism almost two fold [1]. For this reason, administration of substantial energy and protein loads are recommended to limit metabolic 'debt' [2–4]. Indeed, it has been hypothesized that optimising nutrient provision to match the increased metabolic demand in this group will reduce mortality [5]. While several nutritional practice guidelines were designed specifically for patients with burns [2,3,5], and support this approach, these guidelines were based largely on expert opinion.

In the critically ill, nutritional therapy is preferentially delivered via the enteral route [6]. Factors such as 'feed intolerance' and fasting for procedures are risk factors for inadequate delivery of enteral nutrition and occur frequently, even in heterogeneous cohorts of critically ill patients [7]. Furthermore, both risk factors appear to be particularly prevalent in critically ill patients with burns [8], which suggest that calorie and protein delivery is attenuated in these patients.

Following burn, glutamine is a conditionally essential amino acid and preliminary data suggests that supplementation improves outcomes [9]. However, in a large heterogeneous group of critically ill patients with multi-organ failure glutamine supplementation appeared harmful [10]. Because of these discordant data the role of glutamine supplementation in critically ill patients with burn remains uncertain [11].

Hitherto there are limited data relating to actual nutritional practices in patients with major burns. Previous observational studies have been single-centre and include only small numbers of patients [12], with the only multi-centre study reporting on nutritional administration as a dichotomous variable (yes or no) that was delivered enterally in the first 48 h [13]. Furthermore, the frequency and dosing schedules of glutamine supplementation are unknown. Finally, important patient-centred outcomes, such as mortality, have not been evaluated with reference to nutritional therapy in this group [14].

Accordingly, we undertook this retrospective analysis of prospectively collected data in mechanically ventilated patients admitted with burn. The objective of this study is to describe current international nutritional support practice in patients with burn and evaluate associations between nutritional practice and patient outcomes.

2. Methods

This international multi-centre observational study utilised data collected from four consecutive international nutrition surveys (INS) (2007–2011). The INS has been described in detail previously [15]. In brief, patients admitted to intensive care units worldwide and who receive mechanical ventilation for >72 h are potentially eligible. For the purposes of this study, we have included only INS patients with a primary diagnosis of burn. Data collected included; patient demographics, admission diagnosis, use of bedside feeding protocols, prescribed and actual energy intake, morning blood glucose, feeding tube placement, reasons for feeding interruption, use of motility agents and use of supplements for each patient recorded daily. Hypoglycaemic episodes were defined as a blood glucose concentration less than 3.5 mmol/L. As the INS is not specifically tailored to describing patients' post-burn, burn surface area was not recorded. Daily data are recorded for a maximum of 12 days per patient. ICU length of stay and hospital length of stay were recorded up to a maximum of 60 days. Patients alive in hospital, or discharged alive prior to 60 days, are considered to be survivors.

Ethical approval for the INS was obtained from the Research Ethics Committee of the Queens University, Kingston, Ontario. In addition, local ethical approval was obtained from each participating site. The need for informed consent from patients or their next of kin was waived for data collected as part of the INS.

2.1. Statistical analysis

Categorical variables are presented as counts and percentages, continuous variables are reported as mean (standard deviation), mean [range], or median [range or interquartile range (IQ)] as appropriate. Energy and protein deficiency is expressed as a mean per day (24 h) for the entire cohort, based on calculating *total energy prescribed by any combination of enteral nutrition, parenteral nutrition or administration of propofol* minus *actual daily energy intake* for all patients. The percentage of goal achieved for energy and protein is for the entire cohort and considers any route of feeding.

Differences between patient-level subgroups were assessed by chi-squared tests for categorical variables, independent Student's *t*-tests for energy and protein deficits and APACHE-II score, and the Mann–Whitney test used for glutamine dosage and mean morning glucose concentrations. Differences by ICU-level subgroups for energy deficit were assessed using multilevel linear models with patients clustered within centre and ICU characteristics entered as a level 2 fixed effect, and via generalised estimating equations with an independent working covariance matrix using a binomial link for mortality and a gamma log link for length of stay. Individual logistic regressions were used for associations between energy and protein deficits, glutamine usage, gender and glucose levels and mortality. Logistic regressions were also adjusted for APACHE-II scores. Change in mortality over time was assessed by using the chi-squared test with three degrees of freedom.

Statistical significance was considered as a p value < 0.05. Analyses were performed using SPSS (v.19, IBM Inc).

3. Results

3.1. Demographics

Ninety patients with burn were identified (2007 $n = 18$, 2008 $n = 32$, 2009 $n = 21$, 2010 no survey performed, and 2011 $n = 19$), contributing a total of 945 study days. Over two-thirds (61/90) of patients were admitted to intensive care units (ICUs) in Canada, the United States, Australia or New Zealand. Eleven patients were from Europe, nine from Mexico, Central or South America, five from Asia and four from South Africa (Table 1).