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Original article

The prevalence of iatrogenic underfeeding in the nutritionally 'at-risk' critically ill patient: Results of an international, multicenter, prospective study

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SUMMARY

Background & aims: Adverse consequences may be experienced by critically ill patients who are underfed during their stay in the intensive care unit. The objective of this study is to determine the prevalence of iatrogenic underfeeding (receiving <80% of prescribed energy requirements) and the variation of these rates in different geographic regions of the world and in different nutritionally 'at-risk' patient populations.

Methods: This was a prospective, multi-institutional study in 201 units from 26 countries. We included 3390 mechanically ventilated patients who remained in the unit and received artificial nutrition for at least 96 h. We report time to start of enteral nutrition and % nutrition received in various geographic regions of the world and we focus on subgroups of 'high risk' patients (those with >7 days of mechanical ventilation, body mass index of <25 or ≥35, and those with a Nutrition Risk In the Critically ill (NUTRIC) score of ≥5). We report rates of novel enteral nutrition delivery techniques and supplemental parenteral nutrition in these high risk patients.

Results: On average, enteral feedings were started 38.8 h (standard deviation: 39.6) after admission, patients received 61.2% of calories and 57.6% of protein prescribed, and 74.0% of patients failed to meet the quality metric of receiving at least 80% of energy targets. There were significant differences in nutrition outcomes across different geographic regions. There were no clinically important differences in nutrition outcomes or rates of iatrogenic underfeeding in patients in different BMI groups nor by NUTRIC score. Of all at-risk patients, 14% were ever prescribed volume-based feeds, and 15% of patients ever received supplemental parenteral nutrition.

Conclusions: Worldwide, the majority of critically ill patients, including high nutritional risk patients, fail to receive adequate nutritional intake. There is low uptake of strategies designed to optimize nutrition delivery in these patients.

1. Introduction

Not all critically ill patients will respond the same to nutrition therapy. Said differently, not all critically ill patients are nutritionally 'at-risk' and will experience harm as a consequence of iatrogenic underfeeding. Recent studies offer insights into who will benefit the most from optimal nutritional therapy (or those who will be harmed the most from iatrogenic underfeeding). In a multicenter observational study [1], Alberda and colleagues showed the beneficial treatment effect of increased calories was only observed in patients with a body mass index (BMI) <25 and ≥35 with no benefit for patients in the BMI 25 to<35 group. Subsequently, others have described a worse clinical outcome in underfed critically ill patients requiring prolonged mechanical ventilation (>7 days) [2]. Finally, we recently proposed a novel nutritional risk assessment tool, the NUTrition Risk in the Critically ill Score (NUTRIC Score), to help discriminate which ICU patients will benefit more (or less) from aggressive protein-energy provision [3]. By considering the severity of the underlying illness, the degree of acute and chronic markers of inflammation and starvation indices, we can quantify the 'risk' of individual patients. We

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demonstrated that those patients with a higher NUTRIC score may benefit the most from optimal nutrition therapy compared to patients with a lower NUTRIC score.

Whereas previous studies have documented widespread iatrogenic underfeeding in all ICU patients [4–8], we sought to determine whether nutritionally 'at-risk' patients were provided optimal nutrition intake. To define nutritionally 'at-risk' patients, we focus our overall analysis on patients who were mechanically ventilated and in the ICU for a minimum of 96 h. In this population of patients, we have shown that receiving up to 80% of their prescribed energy requirements is associated with a reduced mortality and the observational studies promoting permissive underfeeding have flawed methods [9]. Increasing beyond 80–85% of prescribed energy requirements did not seem to affect subsequent mortality so at a minimum, as a quality indicator, we posit that nutritionally 'at-risk' patients should receive at least 80% of their prescribed energy requirements [9]. Our previous observational work has demonstrated that some sites are able to consistently achieve this level of performance [10]. Moreover, novel enteral feeding techniques (PEP uP protocol [11]) and supplemental parenteral nutrition (sPN) have been promoted as strategies for minimizing the protein-energy deficit in these patients [12].

The objective of this study is to determine the prevalence of iatrogenic underfeeding (receiving <80% of prescribed energy requirements) in nutritionally 'at-risk' (>96 h mechanically ventilated) patients and the variation of these rates in different geographic regions of the world. We also describe the prevalence of iatrogenic underfeeding in pre-specified subgroups of 'higher risk' patients: those with >7 days of mechanical ventilation; BMI of <25 and ≥35; and those with a modified NUTRIC score of ≥5 compared to low risk patients to assess whether such high risk patients have been adequately identified and fed differently. In addition, we describe the utilization of novel EN feeding techniques and sPN in these at-risk patients and the subgroups of high-risk patients. Finally, we performed a logistic regression analysis to determine those patient, ICU and hospital characteristics that are associated with optimal nutrition practices (lowest rates of iatrogenic underfeeding).

2. Methods

We used data from a large international multicentre observational study of nutrition practices in the ICU conducted in 2013. The methods of this recurring survey are similar to previously published studies [1,9]. In short, participating ICUs were required to have a minimum of 8 beds and the ability collect all data within the study timeframe, and a medical professional with knowledge of clinical nutrition to collect the data. Geographical regions were defined in order to identify trends in practice in different parts of the world. Sites were divided approximately by continent, unless there were a very large number of sites in a particular country (e.g. US and Canada) in which case these countries were separated further into distinct regions. Sites from countries or continents (e.g. Mexico, Africa) with too few sites to comprise a unique region were contacted and asked which region they viewed their practices as most similar to, in order to determine the most appropriate regional grouping (e.g. the only Mexican site was grouped with all other Latin American sites).

Eligible patients were critically ill adult patients mechanically ventilated prior to ICU admission or within the first 48 h, who stayed in the ICU for at least 72 h. On the first day of the study (May 15, 2013) sites screened all patients located in their ICU and began collecting data on all eligible patients. Sites continued to screen each new patient admitted to the ICU, with the goal of identifying 20 consecutive eligible patients. Patient care was not standardized or influenced at any point during this observational study. For the purposes of this study, we included only patients who remained in ICU and received artificial nutrition for >96 h from ICU admission.

In the context of this large-scale, multicenter study, observational study designed to describe current practices, no effort was made to standardize or influence the care of patients. For each patient, data collected included patient characteristics and ICU admission information, baseline nutrition assessment, daily nutrition data, and 60-day patient outcomes. Baseline nutrition assessment included the method of calculation (e.g. indirect calorimetry, predictive equations, weight-based formulas) and weight used (i.e. actual, adjusted, or ideal) in estimating nutritional requirements and the total calories and protein prescribed. Prescribed calories and protein referred to the calories and protein provided by the goal feeding regimen determined at the initial assessment, using enteral or parenteral nutrition (EN/PN), according to the physician or dietitian's recommendation. Data variables required to calculate an NUTRIC score (age, APACHE II, SOFA, comorbidities, and days in hospital prior to ICU admission) were also collected at baseline. Daily nutrition data, which included, initial feeding strategy, type and amount of nutrition received, was collected in the ICU until ICU discharge or death, or for a maximum of 12 days. Patient outcomes were collected in-hospital, and included the date of mechanical ventilation discontinuation, ICU and hospital discharge, and

Table 1
Characteristics of participating sites.

	All sites (n = 201)
Hospital type	
Teaching	170 (85%)
Non-teaching	31 (15%)
Size of hospital (beds)	
Mean (range)	583 (50–2500)
Multiple ICUs in hospital	
Yes	125 (62%)
ICU structure	
Open	50 (25%)
Closed	148 (74%)
Other	3 (1%)
Case type[a]	
Medical	176 (88%)
Neurological	132 (66%)
Surgical	170 (85%)
Neurosurgical	115 (57%)
Trauma	126 (63%)
Cardiac surgery	68 (34%)
Pediatrics	33 (16%)
Burns	33 (16%)
Presence of medical director	
Yes	185 (92%)
Size of ICU (beds)	
Mean (range)	17 (4–86)
Presence of dietician(s)	
Yes	163 (81%)
Full time equivalent dietician (per 10 beds)	
Mean (range)	0.50 (0.05–2.22)
Presence of feeding protocol	
PEP uP protocol	13 (6%)
Other protocols	142 (71%)
No protocol	46 (23%)
Regions	
Canada	24 (12%)
Australia and New Zealand	36 (18%)
USA	51 (25%)
Europe and South Africa	35 (17%)
Latin America	14 (7%)
Asia	41 (20%)

Descriptive characteristics of participating sites. ICU-intensive care unit.
[a] A site may admit more than one case-mix group of patients to their site so the totals are >100%.