Clinical Nutrition ESPEN 23 (2018) 162–166

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

A prospective study of energy and protein intakes in critically ill patients

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ARTICLE INFO

Article history:
Received 2 December 2015
Accepted 17 October 2017

Keywords:
Energy intake
Protein intake
Intensive care unit
Critically ill patients

SUMMARY

Background & aims: Providing adequate and appropriate food and nutrients satisfying the patients' safe nutritional need is one of the most important care practices for critically ill patients (CIPs) in ICU settings, and is strongly related to the patients' safety.

Methods: In this prospective cross-sectional study data were collected from a 52-bed medical intensive care unit on 777 consecutive patients in six different ICUs. The patients' weights and heights were measured based on ulna length, knee height, MAC, Calf C, and Wrist C. Also, patient weight change history was asked for. All currently in-use dietary supplements and formulas in the ICU settings were checked for their ingredients. The patients' nutritional need was calculated individually for the disease state based on dietary ESPEN guidelines.

Results: Mean ICU and hospital stay duration was 14.45 ± 11.81 and 15.38 ± 11.88 days respectively. Mean energy and protein requirements in the target population were 1804.61 ± 201.76 Kcal/day and 77.94 ± 12.72 gr/day, respectively. Mean actual energy and protein intakes were 1052.75 ± 561.25 Kcal/day and 35.38 ± 23.19 gr/day, respectively. Satisfaction percents for mean energy and protein requirement in the total population were 58.34% (1052.75/1804.4) and 45.41% (35.38/77.9), respectively. In 21.4% and 4.4% of the studied group, energy and protein intakes were about 75–100% of the patients' actual need, respectively. Another data analysis for patients with over 10 days of inpatient time showed that only 14.2% of patients had energy intakes, and only 3.2% of them had protein intakes in the range of 75–100% of their requirements.

Conclusion: Results showed that energy and protein intakes in CIPs are low, disproportionate to their requirements. Therefore, actual dietary intake records, individual dietary requirement calculation, and individual dietary planning in relation with the patients' disease and stress should be considered. Such an accurate nutritional care process can promote patient safety.

1. Introduction

ICU patients are often hypermetabolic, which can cause malnutrition [1–3]. Malnutrition is associated with mortality in these patients. One important unanswered question that has recently become more prevalent in the critical care literature is regarding the dosage or amount of nutrition. There is a general consensus that excessive hypocaloric or hypercaloric feeding should be avoided, yet there is controversy about what the feeding target should be [3–5] (see Tables 1and 2).

Delivering food and nutrients for an optimal nutrition according to the patients' needs through one of the possible routes such as enteral (EN) or parenteral (PN) in critically ill patients (CIPs) is a cornerstone for intensive care practice. CIPs that do not receive enough nutrients through oral feeding should be prepared for EN or PN nutritional support [6–8].

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https://doi.org/10.1016/j.clnesp.2017.10.007

List of abbreviations

BMI	Body Mass Index
LOS	Length of Stay
GRV	Gastric Residual Volume
CVA	CerebroVascular Accident
GICU	General Intensive Care Unit
NICU	Neurological Intensive Care Unit
SICU	Surgical Intensive Care Unit
MICU	Medical Intensive Care Unit
ICU	Intensive Care Unit
MAC	Mid Arm Circumference
Calf C	Calf Circumference
GCS	Glasgow Coma Score
EN	Enteral Nutrition
PN	Parenteral Nutrition
ESPEN	European Society for Enteral and Parenteral Nutrition
CIPs	Critically Ill Patients

There is a general agreement that EN is preferable to PN for nutritional support [7]. EN is associated with fewer side effects and discomforts, such as a lower infection incidence rate and lower length of hospital stay and costs [8,9]. The problem is the impossibility of satisfying all patients' needs with EN most of the times [10,11]. Patients with long ventilator dependence are frequently susceptible to over- and under-feeding because there are frequent impeding factors such as GI intolerance, frequent tube feeding interruptions, and the need for diagnostic tests or procedures. A high gastric residue volume (GRV), vomiting, nausea, ileus, bloating and diarrhea are the most common GI discomforts [12,13].

Different studies have revealed that low calorie and protein intakes, mostly less that 70% of the patients' requirements, can be related to unfavorable clinical outcomes. Unfortunately in most cases the delivered amount of nutrition is not sufficient [12–14].

Table 1
Demographic and baseline characteristics of patients.

Variable (measure)	Value
Age (mean ± SD)	61.32 ± 18.85
Sex (n, percent)	Female: 46.66%
	Male: 53.33%
Weight (means ± SD)	62.66 ± 12.20
Height (means ± SD)	167.59 ± 11.80
Mid Arm Circumference (mean ± SD)	24.75 ± 5.22
Calf Circumference (mean ± SD)	29.87 ± 5.94
BMI Category (n, percent)	
≤18.49	20.1%
18.5–24.9	53.1%
25–29.9	20.2%
30–34.9	5.7%
35–39.9	0.6%
≥40	0.1%
Type of feeding rout (n, percent)	
Oral	14/4%
EN	68.2%
PN	7.5%
Mixed	9.9%
Types of EN route (n, percent)	
NG	94.2%
PEG	4.3%
PEJ	1.5%
Ventilator Dependence	
Yes	62.9%
No	37.1%
Length ICU stay (mean ± SD)	14.45 ± 11.81

Table 2
Mean actual energy and protein intakes and requirements.

Variable (measure)	Mean ± SD	P value
Actual energy intake (Kcal/day)	1052.75 ± 561.25	P < 0.001
Energy requirement (Kcal/day)	1804.61 ± 201.76	
Actual protein intake (Kcal/day)	35.38 ± 23.19	P < 0.001
Protein requirement (Kcal/day)	77.9 ± 12.72	

Recently, guidelines have suggested that starting EN within 24 h of ICU admission is important for patients with hemodynamically stable conditions [15–17]. Most methods used for the calculation of energy requirement in ICU patients include Harris Benedict formula, indirect calorimetry, and guidelines based on established recommendations [16–19].

Different observational studies have revealed that although there are different cut-offs in rules for defining nutritional intakes as sufficient or insufficient, most intakes are much lower than the patients' requirements [11,14].

2. Material and methods

2.1. Study design

This study conducted as a prospective observational study from February 2012 to October 2014. Patients were recruited from 6 different ICUs including GICU, NICU, SICU, MICU, and stroke and post-surgery ICU from Imam Khomeini educational hospital, Urmia, Iran. Study performed after inspection by Medical Ethics Committee of the Urmia University of Medical Sciences about any possible ethical issues.

2.2. Participants

1183 adult CIPs, 18 years or older, who had been admitted to the 6 different ICUs were screened for eligibility. Inclusion criteria were being over eighteen years old, over a 4-day stay in ICU, receiving at least one type of feeding (Oral, EN, and PN) or their combination.

Participants were consecutive patients who had entered ICU and stayed for more than 96 h with feeding having been started in the first 72 h of admission, from February 2012 to October 2014. From the target population, 20.03% (237) died, 6.08% (72) with a GCS equal or less than 3, 3.88% (46) had less than 4 days of LOS, and 4.31% (51) had a delayed feeding initiation (feeding starting after the 4th day), and thus were excluded from study. Therefore, finally 777 participants were included.

2.3. Data collection and measurements

Data about familial, medical and drug history, and laboratory test results were extracted from the patients' medical records. Anthropometric and delivery data were collected by direct measuring or were extracted from medical records which had been recorded by nurses or registered dietitians. The patients' heights were measured by ulna length measurement, and then their ideal body weights were computed. Body sizes were determined after wrist circumference measurement. For predicting their current body weight, the most recent body weight history was asked from the patients' surrogates, and also estimation was performed by Krandal and Lorenzo weight prediction formulas for CIPs. Mid arm muscle circumference (MAC) and calf circumference (CC) for each patient was measured and recorded in an specifically provided nutritional form. Evaluation of the patients' malnutrition status was conducted based on their body mass index (BMI). After height and weight prediction, patients'