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Original Article

Current Nutritional Statuses and Gastrointestinal Complications in Critically Ill Patients Admitted to ICUs in Iran: A Cross-Sectional Study

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ABSTRACT

Background and Objectives: Adequate nutrition is closely linked to clinical outcomes. Therefore, this study was carried out to assess nutritional statuses of the ICU patients in Isfahan, Iran.

Materials and Methods: In this cross-sectional study, 55 critically ill adult patients receiving enteral nutrition for a minimum of seven days were participated. Nutritional screening, including acute physiology and chronic health evaluation (APACHE) score, nutrition risk in critically (NUTRIC) score and nutritional assessments of laboratory data, energy and protein balance, was carried out. Moreover, gastrointestinal problems was assessed.

Results: In total, 55 patients (35 men and 20 women) with the median [IQR] age of 49 [18–77] years and the median [IQR] weight of 75 (55–100) kg were included in this study. The average of albumin concentrations were 3 g/dl ±0.7 in ICU inpatients, indicating decreased albumin levels compared to normal ranges (3.5–5 g/dl). During inpatient period, nutrition screening showed a median range of NUTRIC score of 3 (2–5) and APACHE score of 23 (18–27). In addition, median range of weight decreased to 71 (50–96) kg. Median intakes of energy and proteins for seven days seemed inadequate (1920 [1200–2740] and 86 [49–129], respectively). After gastrointestinal assessment, 20% of the participants had nausea and vomiting, 10% had obstipation, 5% had diarrhea and 20% had enteral feeding intolerance (assessed by GRV > 250 mL at repeated regular (6 h) measurements).

Conclusions: Results have suggested that although imbalanced energy, insufficient protein intakes, and gastrointestinal complications are common in ICU patients especially in women, risk assessment of malnutrition has shown no critical results. Therefore, designing and providing more sensitive methods for the screening of nutrition and assessment of nutritional adequacy is essential to prevent malnutrition in societies.

Keywords: Intensive care unit, Malnutrition, Nutrition assessment, Gastrointestinal complication

Introduction

Malnutrition is a spread problem in hospitalized patients; however, this public health problem remains widely unrecognized (1). Poor nutritional statuses can occur due to deficiencies in diet plans, increased nutritional requirements due to illness, complications of diseases, and poor nutrient absorption, or a combination of them (2, 3). Based on previous studies, prevalence rates of the hospital malnutrition have been reported at 20–50%, depending on the patient population, and criteria of diagnoses (2-4). In Iran, rates of the hospital malnutrition are reported as nearly 43% (5). It is well known that insufficient nutritional consumptions can include significant effects in increased risks of infectious and non-infectious complications, prolonged durations of stay at hospitals and intensive care units (ICUs) and further frequent readmissions and mortalities (6-14). In critically ill patients, this condition can be induced by systemic inflammatory responses to critical illnesses or traumas, which increases significant metabolic demands and results in development of malnutrition and further increases in risks of infectious complications, multiple organ dysfunctions and mortalities (15, 16).

Numerous studies have revealed that nutritional statuses and cares include significant effects on hospitalization outcomes (17-19). Therefore, nutritional assessment and screening are integral parts of the treatment in critically ill patients (20-22). Biochemical markers, anthropometric indices and food consumption patterns are common

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nutritional assessment criteria of the ICU patients (20). Studies have shown that low circulating levels of magnesium, phosphorus and albumin can lead to energy deficiency and cardiac and neuromuscular disorders (23). Decreased serum potassium levels can results in severe muscle ache and cardiac arrhythmia and arrest (24). Previous observational study has indicated that malnutrition is spread in ICU patients. The study assessed nutritional statuses of 100 critically ill patients admitted to ICUs in a hospital of Al-Zahra University from February to April, 2012. However, daily calorie and protein balances and occurrence of gastrointestinal problems were not assessed in that study (25). Furthermore, biomarkers and indices such as albumin, blood urea nitrogen (BUN), creatinine, potassium and magnesium levels were assessed (25). Due to the high prevalence of hospital malnutrition in Iran, the current study was carried out to assess nutritional status in ICU patients receiving nutritional supports in Isfahan, Iran.

Materials and Methods

Study design

This cross-sectional study was carried out to assess clinical nutrition cares in 55 critically ill adults in ICUs in Isfahan from March to May, 2019.

Inclusion criteria

Patients over 18 years old, hospitalized more than three days in ICUs, received EN and/or PN on the screening day and were hemodynamically stable were recruited to this study. The observation period was described from the screening day (Day 1) for maximum of seven days.

Exclusion criteria

Patients admitted to the hospital for less than three days were excluded from the study because effects of nutrition on these patients were not considerable. Moreover, data of the patients were collected.

Data collection and variables

Nutritional statuses were assessed through measurement of anthropometric indices, clinical characteristics, laboratory values and medical histories by a registered dietitian using standard methods. Estimate weight was measured indirectly using Devine's method due to the lack of access to accurate weight measuring instruments (25). Mid upper arm circumference was used to estimate body mass index (BMI) (26). Biochemical indices such as blood glucose, albumin, magnesium, potassium, and BUN and creatinine levels were assessed during hospitalization. Dietary assessment was carried out to assess nutritional statuses, nutritional risks, types and volumes of the nutrition therapy and daily calorie and protein balances during the observation period. Patients' nutritional statuses were assessed based on the nutritional risks in critically ill (NUTRIC) score (27, 28). The NUTRIC score included six variables counting age, acute physiology, and chronic health evaluation (APACHE) II score, sequential organ failure assessment (SOFA) score, number of co-morbidities, days from hospital to ICU admission and interleukin-6 (IL-6) (29). Gastrointestinal problems were assessed in these patients. Available data from the patients' records were collected for each day of stay in ICUs for seven days. The formula used by the patients during hospitalization included 1 kcal of energy per milliliter of the formula; from which, 15% derived from proteins. Calorie balances were calculated as differences between daily caloric targets and daily calories provided by enteral and/or parenteral nutrition and other sources of calorie intakes. Daily protein balances were calculated as differences between clinician-derived daily protein targets and daily protein intakes (30). Daily calorie targets were derived by the clinician using standard formulas (25 kcal/kg actual body weight on the screening day for patients in ICUs with no obesity) and daily protein targets using standard formulas (1.2 g/kg) (31). Cumulative calorie and protein balances were reported as sum of the mean daily balances for all days divided to seven days.

Statistical analysis

Quantitative variables were presented as mean ±SD (standard deviation) and qualitative variables were reported as frequencies (%).Primary outcomes were presented as continuous variables using mean differences between daily calorie targets and daily calorie intakes. Also, calorie intake of the patients were summarized as numbers and proportions in each of the following categories of > 90% of daily targets, and calorie deficits (≤ 90% of daily targets). In addition, nutritional characteristics of patients in each sex were categorized based on the following parameters: nutritional statuses, types of nutritional therapy and 7-days protein intake. The APACHE II score also was clarified based on severity of illness for each patients.

Results

The current study population included 35 men and 20 women with a median age of 30 and 52 years, respectively. Demographic, anthropometric measurements and biochemical values of the ICU inpatients are shown in Table 1. Of the patients, 7.3% included BMI of less than 18.5. The most common primary reason for admission to ICUs included trauma (45.45%). The median points of APACHE-II and NUTRIC were 22 score (23 for males and 22 for females) and 3 score, respectively. The NUTRIC score in our study revealed that the risk of malnutrition was mild. The average albumin concentration included 3 g/dl ±0.7 in ICU inpatients, demonstrating decreases in albumin levels compared to normal ranges (3.5–5 g/dl) (32). Plasma magnesium and potassium levels were 0.65 and 4.06 mmol/L respectively, which showed hypo-magnesia in patients (33). Of 55 patients admitted to ICUs, proportions of enteral, enteral/parenteral and total parenteral nutrition included 76.4, 18.2 and 5.5%, respectively (Table 2). Analysis of the cumulative calorie balances from seven days revealed that the median 7-day energy intake included 1691 kcal, while the median target energy included 1851 kcal. Results showed that calorie intake in men was less than 90% of the target calorie intake, while it was sufficient in women (Fig. 1). The median of 7-day protein intake was 69 g, whereas the median target protein was 84 g, showing that daily intake of protein was less than 1.2 g/kg in patients (Fig. 2).

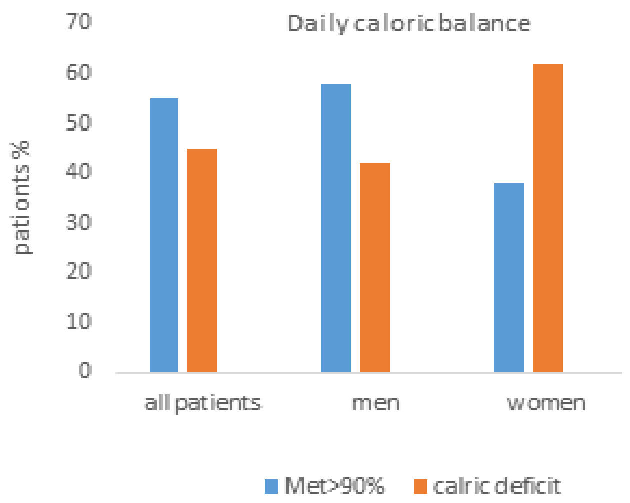

Figure 1. Daily caloric balance based. *Defined as divided the daily caloric intake based on sum of calories from enteral and/or parenteral nutrition and other sources of caloric intake on caloric target=

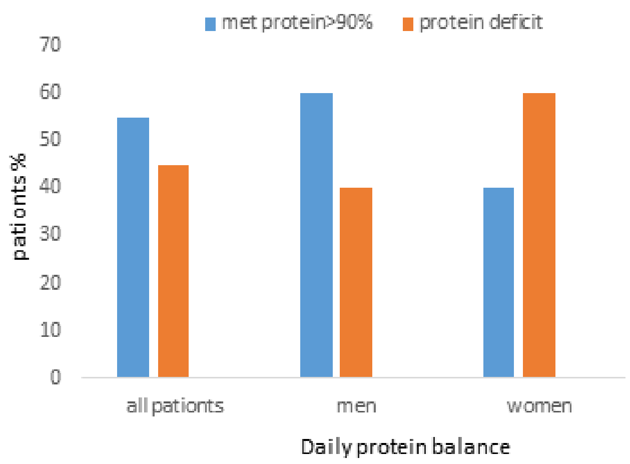

Figure 2. Daily protein balance based. *Defined as divided the daily protein intake based on sum of protein from enteral and/or parenteral nutrition and other sources of protein intake on protein target

Table 1. Baseline characteristics of the ICU patients

		All patients (n =55)	Male(n=35)	Female(n=20)
Age, median [IQR], y		37(18-80)	30(18-80)	52(31-77)
Weight in bed, median [IQR], kg		75(55-100)	70(60-100)	75(55-88)
BMI in bed, median [IQR], NO (%)	<18.5	4(7.3)	4(11.4)	0
	18.5-24.9	21(38.2)	14(40)	7(35)
	25-30	24(43.6)	14(40)	10(50)
	>30	6(10.9)	3(8.6)	3(15)
APACHE-II score, median [IQR]		22(18-27)	23(18-27)	22(20-27)
NUTRIC score, median [IQR]		3(2-5)	3(2-5)	3(2-5)
Admission type	Medical, NO (%)	20(36.6)	9(25.7)	11(55)
	Surgical, NO (%)	10(18.8)	2(1)	8(40)
	Trauma, NO (%)	25(45.45)	20(57.3)	5(25)
Weight during assessment, median [IQR], kg		73(50-96)	73(50.7-96)	77.6(55-91)
Albumin (g/dl), mean (SD)		3(0.7)	3(0.7)	2.9(0.6)
Blood glucose		145(62)	122(19)	186(86)
Magnesium (mmol/L), mean [min-max]		0.65(0.22-1.41)	0.7(0.25-1.54)	0.6(0.2-1.31)
Potassium (mmol/L), mean [min-max]		4.06(3.0-5.5)	3.87(3.0-5.5)	4.4(3.4-5.5)
BUN(mg/dl), mean (SD)		16.9(5)	20(8)	11(4)
Creatinine (mg/dl), mean (SD)		1.1(0.9)	1.1(0.8)	1.1(0.6)

Table 2. Enteral and parenteral feedings in patients

		All patients (n =55)	Male(n=35)	Female(n=20)
Feeding rout	EN, NO (%)	42(76.4)	28(80)	14(70)
	EN/PN, NO (%)	10(18.2)	5(14.3)	5(25)
	TPN, NO (%)	3(5.5)	2(5.7)	1(5)
7-days energy intake, Kcal, Median [IQR]		1691(750-2100)	1600(750-2100)	1830(1250-2100)
Energy target, kcal, median [IQR]		1851(1500-2800)	1850(1600-2800)	1870(1500-2300)
7-days protein intake, g, Median [IQR]		69(38-90)	68.5(38-90)	66(38-88)
Protein target, g, Median [IQR]		84(56-113)	81(62-113)	88(56-90)

Table 3. Occurrence of gastrointestinal problems in patients

	All patients (n =55)	Male(n=35)	Female(n=20)
Diarrhea, NO (%)	3(5.5)	1(3)	2(10)
Obstipation, NO (%)	7(12.7)	6(17)	1(5)
Gastric aspiration volume > 250 mL, NO (%)	11(20)	9(25.7)	2(10)
Nausea and vomiting NO (%)	10(18.2)	9(25.7)	1(5)

Overall, 5.5% of the patients suffered from diarrhea, 12.7% from obstipation, 20% from gastric residual volumes of greater than 250 mL and 18.2% from nausea and vomiting (Table 3). Routes of feeding in patients with calorie deficits on the screening day are shown in Fig. 3; from which, the most common route was enteral feeding.

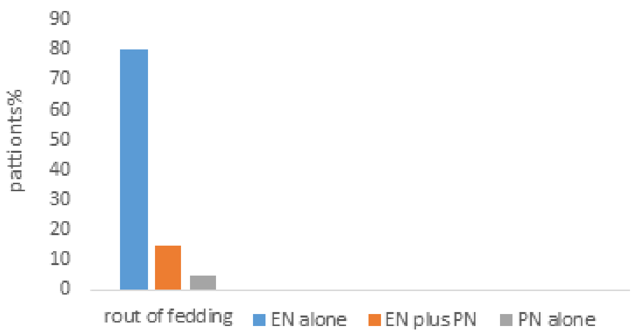

Figure 3. Proportion of patients with caloric deficit based on route of feeding in screening day 1. Abbreviations: EN: enteral nutrition, PN: parenteral nutrition

Discussion

In this cross-sectional study of nutritional statuses and gastrointestinal complications in ICU patients, critical malnutrition statuses were not observed in ICU inpatients based on the NUTRIC score. However, gastrointestinal problems were common in these cases. Moreover, decreases in serum albumin levels and hypo-magnesia were seen. Patients' protein and energy intakes were limited. In the present study, albumin levels were lower than normal ranges (32). Decreased levels of albumin, total protein and phosphorus were associated to malnutrition in the present study and patients with good nutritional statuses included higher albumin levels than those malnourished patients did (25, 34). It is noteworthy that each 10 g/L decrease in serum albumin concentration significantly increased the odds of mortality by 137%, morbidity by 89%, prolonged ICU and hospital stays by 28 and 71% respectively and increased resource utilization by 66% (35). Evidence indicated that two important potential confounding variables, malnutrition and inflammation, might explain the low albumin level effect (35). Interestingly, increased dietary protein intake and nutritional supplementation can improve low circulating albumin concentrations.

In further analysis, magnesium levels decreased in male and female ICU patients, compared to the normal range (33). Studies have shown that decreased circulating magnesium can be associated with higher mortality rates in critically ill patients (36). However, low levels of magnesium may result in decreased gastrointestinal (GI) absorption and increased renal loss, diarrhea, malabsorption and inadequate dietary protein and energy intakes (37). In critically ill patients with mild to moderate decreased plasma magnesium, administration of 1 g (8 mEq) of intravenous Mg can increase serum Mg concentrations by 0.15 mEq/L within 18 to 30 h (38). Treatment of the associated electrolyte abnormalities and general management of the patients with focus on their nutritional therapy are necessary (39). Moreover, the current study has shown that daily calorie intake of the patients was lower than 90% of the energy targets. In published studies, the most important causes of malnutrition in ICU inpatients include calorie intake deficiency during the first days of admission and mechanical ventilation, which usually result in higher metabolic rates and further complications (40-42). Moreover, recent studies have shown that low calorie intakes are linked to nosocomial bloodstream infections and include negative effects on clinical outcomes of the ICU patients (43, 44).

In the last stage of analysis, consumed protein quantity failed to meet the target requirement (1.2 g/kg). It is noteworthy that the formula used by the patients included 15% of proteins, which are not sufficient for the patients.

The earlier studies have shown that lower protein intakes in ICU patients can lead to prolonged hospital stays, increased risks of malnutrition and impaired clinical outcomes (25, 30, 45). Moreover, studies have shown that this lack of adequate protein intake may be due to insufficient energy intake. Supplemental PN can improve energy and protein deliveries and potentially decrease risks of clinical side effects (30). Despite the low risks of malnutrition in patients this study, patients possibly develop malnutrition in long times. Therefore, necessary assessments must be carried out later since newly admitted patients receive insufficient energy and protein. In this study, more than half of the patients suffered from gastrointestinal problems. Obviously, gastrointestinal problems are common complications of the critical illnesses that can be characterized by constipation, abdominal distension, pain, nausea and vomiting and is associated with significant morbidities such as feeding intolerance, inadequate absorption of nutrients and medications and prolonged hospitalization (46). In ICUs, these gastrointestinal problems are linked to gastrointestinal motility, altered by drugs, immobility, surgery, enteral feeding, head and spinal injuries, inflammation and sepsis (46). Therefore, understanding causes of gastrointestinal intolerance and resolving them can significantly affect the clinical status of ICU patients.

Strengths of the study

Strengths of the study include assessment of nutritional statuses of ICU patients that can be used in future interventions and use of standard instruments to assess biochemical values. However, it is noteworthy that the current study included several limitations as follows: 1) cross-sectional study and follow-up impossibility, 2) lack of direct calorimeter devices and inability of accurate calculation of the necessary calories, 3) lack of body composition analyzers and use of arm circumference to estimate current weights, and 4) lack of other biochemical and clinical tests other than hospital routine tests.

Conclusions

In conclusion, these results have suggested that clinical and biochemical factors such as energy and protein requirements, gastrointestinal complications and magnesium levels are abnormal in ICU patients, especially in women. However, risk assessments of the malnutrition have shown no critical results using nutritional screening tools. Therefore, these cases can be used as warning predictors of the malnutrition in long terms and must be reassessed in the future. In addition, well-designed clinical trials are necessary to clarify all aspects of the nutritional supplementation.

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