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Original Article

Nutritional Assessment in Critically Ill Patients

Najmeh Hejazi[1], PhD;
Zohreh Mazloom[1], PhD;
Farid Zand[2], MD;
Abbas Rezaianzadeh[3], MD, MPH, PhD;
Afshin Amini[4,5], MD

[1]Nutrition and Food Sciences Research Center, Department of Clinical Nutrition, School of Nutrition and Food Sciences, Shiraz University of Medical Sciences, Shiraz, Iran;
[2]Shiraz Anesthesiology and Critical Care Research Center, Department of Anesthesia, Nemazee Teaching Hospital, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran;
[3]Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran;
[4]Department of Anesthesia, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran;
[5]Vice Chancellor for Clinical Affairs, Shiraz University of Medical Sciences, Shiraz, Iran

Correspondence:
Zohreh Mazloom, PhD;
Department of Clinical Nutrition, School of Nutrition and Food Sciences, Shiraz University of Medical Sciences, P.O. Box: 71645111, Shiraz, Iran
Tel: +98 917 1111527
Fax: +98 71 37251008
Email: zohreh_mazloom@yahoo.com
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What's Known

- Malnutrition increases during ICU stay.
- International guidelines determine the cutoff point for calorie and protein intake in ICU patients.

What's New

- We determined the prevalence of malnutrition in the ICU on the days of admission and discharge and the best method to assess nutritional status in ICU patients.
- This study shows the mean calorie and protein intake in our ICU patients.

Abstract

Background: Malnutrition is an important factor in the survival of critically ill patients. The purpose of the present study was to assess the nutritional status of patients in the intensive care unit (ICU) on the days of admission and discharge via a detailed nutritional assessment.

Methods: Totally, 125 patients were followed up from admission to discharge at 8ICUs in Shiraz, Iran. The patients' nutritional status was assessed using subjective global assessment (SGA), anthropometric measurements, biochemical indices, and body composition indicators. Diet prescription and intake was also evaluated.

Results: Malnutrition prevalence significantly increased on the day of discharge (58.62%) compared to the day of admission (28.8%) according to SGA ($P<0.001$). The patients' weight, mid-upper-arm circumference, mid-arm muscle circumference, triceps skinfold thickness, and calf circumference decreased significantly as well ($P<0.001$). Lean mass weight and body cell mass also decreased significantly ($P<0.001$). Biochemical indices showed no notable changes except for magnesium, which decreased significantly ($P=0.013$). A negative significant correlation was observed between malnutrition on discharge day and anthropometric measurements. Positive and significant correlations were observed between the number of days without enteral feeding, days delayed from ICU admission to the commencement of enteral feeding, and the length of ICU stay and malnutrition on discharge day. Energy and protein intakes were significantly less than the prescribed diet (26.26% and 26.48%, respectively).

Conclusion: Malnutrition on discharge day increased in the patients in the ICU according to SGA. Anthropometric measurements were better predictors of the nutritional outcome of our critically ill patients than were biochemical tests.

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Keywords ● Malnutrition ● Critical illness ● Intensive care unit, Anthropometry ● Nutrition assessment

Introduction

Malnutrition is a prevalent consequence of hospitalization, especially in critically ill patients admitted to the intensive care unit (ICU).[1] According to Kubrak et al.,[2] the prevalence of malnutrition was 13 to 78% in acute care patients between1996 and 2005. Malnutrition can be the result of both hypermetabolism

and inadequate intake of energy and protein in these patients.[3,4] Research showed that having some degree of malnutrition prior to admission to the ICU in seriously ill patients was able to compromise micro- and macronutrientreserves.[5,6] Nutrient deficiency has been correlated with a prolonged length of ICU/hospital stay and is strongly associated with increased morbidity and mortality among critically ill patients.[1,3] Medical nutrition therapy may lessen morbidity, mortality, and length of ICU stay. Therefore, a timely assessment of nutritional status in critically ill patients is important to prevent or minimize nutritional crises and to monitor nutritional therapy.[7] In addition, early nutritional screening is a key factor in appropriate nutritional intervention that may reduce the length of ventilator dependency, ICU/hospital stay, and mortality.[8,9]

A number of clinical indicators such as anthropometric measurements (e.g., body weight, body mass index [BMI], mid-arm muscle circumference [MAMC], triceps skinfold thickness[TSF], and calf circumference), body composition markers and biochemical indices (e.g., visceral protein [total protein, albumin, and pre-albumin]), and immune competence markers (e.g., lymphocyte count) together with nutrition screening tools can be used to determine the nutritional status of critically ill patients.[2]

Subjective global assessment (SGA) is a clinical questionnaire to assess nutritional status based on the patient's history and physical examination at bedside. This screening tool does not need any laboratory data. SGA has the most diagnostic value for critically ill patients among the different nutrition screening tools.[2,10]

The purpose of the present study was to assess the nutritional status of critically ill patients on the days of ICU admission and discharge via different clinical indicators. In addition, the feeding pattern of the patients, including the type of feeding and mean macronutrient intake, was also recorded to determine the adequacy of calorie and protein intake in these critically ill patients during ICU stay. This study also aimed to determine the factors which influenced the patients' malnutrition on discharge day from the ICU. To the best of our knowledge, this is the first study on such predictors in critically ill patients.

Patients and Methods

Study Design

This follow-up study was conducted in 8ICUsat Nemazee and Rajaei teaching hospitals, Shiraz, Iran, from September 2012 to April 2013. Four ICUs from Nemazee Hospital (Emergency ICU [14 beds], General ICU [10 beds], Central ICU [4 beds], and Internal ICU [11 beds]) and 4ICUs from the Trauma Center of Rajaei Hospital (ICU_1 through ICU_4 [32 beds]) took part in this study.

Study Population

Using the formula $n=Z^2$ (SD^2/d^2) and considering Z=1.96 (95% confidence interval), SD (standard deviation)=4, and d (margin of error in estimating mean or effect size)=0.7, we decided that the sample size of the study was 125 critically ill patients.

All patients admitted to the above-mentioned units were screened for eligibility. A total of 708 were screened, and 125 patients prospectively participated in this study. The inclusion criteria comprised minimum age of 18 years, minimum expected ICU stay of 7days, and clinical situation preventing oral nutrition. Patients were excluded from the study if they were transferred from other hospitals or ICUs and were HIV or hepatitis B/C surface antigen positive (figure 1).

The study was approved by the Clinical Research and Ethics Committee of Shiraz University of Medical Sciences and was carried out in accordance with the Declaration of Helsinki. Well-informed written consent was obtained from the patients (when possible) or their next of kin.

Data Collection

The patients' demographic and clinical characteristics were recorded at the beginning of the study (ICU admission); these encompassed age, sex, diagnosis, admitting service (medical vs. surgical), and the admission Acute Physiology and Chronic Health Evaluation (APACHE) IV score. The Sequential Organ Failure Assessment (SOFA) score and the Glasgow Coma Scale

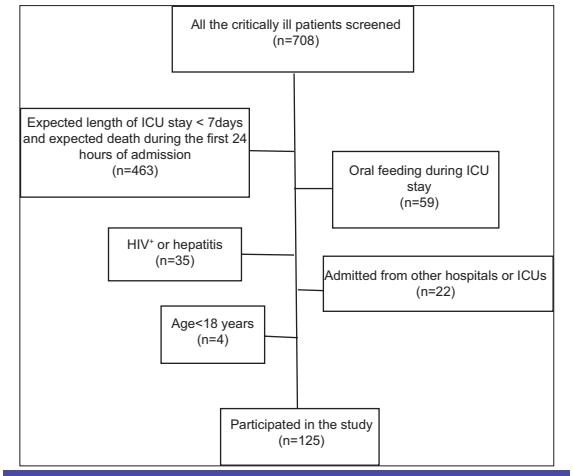

Figure 1: Number of the patients excluded from the study and the reasons due to screening

(GCS) were also calculated for each patient on ICU admission and discharge days.

Anthropometric indices were assessed on ICU admission and discharge days for each patient. These measurements included height based on ulna length[11] and weight as measured with a bedside scale or, if not feasible, as estimated from the patient's height. BMI was calculated by dividing weight (kg) by squared height (m). Mid-upper-arm circumference (MUAC) and calf circumference were measured using a flexible meter. TSF was determined to the nearest millimeter with a Lange skinfold caliper having the pressure of 10 g/mm^2 of contact surface area. MAMC was calculated using the $MAMC_{(cm)}=MUAC_{(cm)}-(TSF_{(mm)}\times 0.314)$ formula. Body cell mass, lean mass weight, fat mass weight, and dry lean mass were measured using a Multi-Frequency Bioelectrical Impedance Analyzer (Bodystat; QUAD SCAN 4000, U.K.) with 4 electrodes connected to the right hand (wrist and middle fingers) and right foot (ankle and above the knuckle of the toe).

A valid and reliable SGA questionnaire for Iranian patients was filled out on ICU admission and discharge days for each patient in the ICU by an expert dietitian.[12] SGA is a comprehensive nutritional assessment tool that is inexpensive and rapid to integrate. It does not need any laboratory evaluation. The SGA questionnaire determines any alternations in body weight (during the preceding 6 months and 2 weeks), dietary intake, gastrointestinal symptoms, functional capacity, and an assumed metabolic demand of the underlying disease. The second part of this questionnaire examines muscle wasting, loss of subcutaneous fat, and the presence of ankle or sacral edema. Each aspect of the questionnaire was scored as A, B, or C to indicate the degree of malnutrition. Score A signified well nourished, B denoted at risk for malnutrition or mildly to moderately malnourished, and C implied severely malnourished.[13]

On ICU admission and discharge days, 5 mL of blood was drawn from each patient to measure biochemical indices. The blood samples were centrifuged at 2000g/min for 10 minutes. The serum was then separated, frozen immediately, and stored at -70 °C until analysis. Total protein, albumin, pre-albumin, magnesium, calcium, phosphorous, and total lymphocyte count were measured. An AutoAnalyzer was employed to measure the total protein and albumin, magnesium, calcium, and phosphorous. The pre-albumin level was also assessed using the turbidimetric method (BioSystems, Spain kit).

The patients' caloric and protein intakes were measured daily and compared to the prescribed diet during ICU stay. The dietary data were analyzed (calorie, protein, carbohydrate, and fat amounts) by an expert clinical dietitian.

The prescription of energy to the patients was based on multiplying the patients' actual (for patients with BMI≤29.9) and target weight (for BMI≥30) in kilogram by 25-30 kcal/kg. The computation of the prescribed protein was based on the severity and type of the patients' disease (0.8-1.5 g/kg/d).[14,15] The assessment of energy and macronutrient (protein, carbohydrate, and fat) intake was done using mean daily energy or macronutrient delivery from enteral or parenteral routes during ICU stay.

Length of ventilator-free days and length of ICU and/or hospital stay (in days) were recorded. Additionally, the rate of mortality while staying in the ICU and in the hospital was also recorded. Days from ICU admission to enteral nutrition and days without enteral feeding while staying in the ICU were recorded as well.

Statistical Analysis

The statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS), version 16 (SPSS Inc., Chicago, IL). The data are expressed as mean±SD and median (interquartile range) based on normal/abnormal distribution or number/percent. The paired *t*-test was used to compare the means of admission and discharge continuous data. The sign test was utilized to compare SGA distribution on ICU admission and discharge days. The Pearson correlation coefficients were performed to assess the relationship between malnutrition on ICU discharge day and nutritional indicators on admission day, length of ICU stay, ventilator-free days in the ICU, days from ICU admission to enteral feeding, and number of days without enteral feeding in the ICU. A hierarchical multiple regression was drawn up onto assess the ability of the 2 dietary measures (mean calorie intake and mean protein intake) during ICU stay to predict malnutrition on discharge day, after controlling for the length of ICU stay. P≤0.05 were considered statistically significant.

Results

Totally, 708 patients admitted to the ICU were screened for 7months, and 125 patients sequentially participated in this follow-up study. All the participants were studied over the length of stay in the ICU. The baseline characteristics of the patients are summarized in table 1.

Table 2 shows the main clinical outcomes in the patients over the study period. On average, the patients stayed in the ICU for 17.9 days and

Table 1: Characteristics of the patients

Variable	n, 125 Mean±SD or n (%)
Age (y)	49±21.2
Gender	
Male	84 (67.2%)
Female	41 (32.8%)
Admission category	
Medical	66 (52.8%)
Surgical	59 (47.2%)
Diagnosis	
Cardiovascular	8 (6.4%)
Neurological	32 (25.6%)
Gastrointestinal	6 (4.8%)
Orthopedic	2 (1.6%)
Renal	2 (1.6%)
Respiratory	8 (6.4%)
Trauma	59 (47.2%)
Sepsis	3 (2.4%)
Cancer	5 (4%)
APACHE† IV score	70±25
Admission SOFA score	8.4±2.9
Admission GCS	7±3.2

APACHE: Acute physiology and chronic health evaluation; SOFA: Sequential organ failure assessment; GCS: Glasgow coma scale; SD: Standard deviation

Table 2: Clinical and nutritional outcomes of the patients

	Mean±SD, Median (IQR)
Length of ICU stay (d)	13 (7-22)
Length of hospital stay (d)	20 (12-39.5)
ICU mortality (n, %)	37 (29.6%)
Hospital mortality (n, %)	45 (36%)
Length of ventilator-free days (d)	4 (0.5-10)
Days from ICU admission to EF (d)	3 (2-5)
Number of days without EF (d)	5.2, 3 (2-6.5)†
Type of feeding (n, %)	
EF	99 (79.2%)
PF	4 (3.2%)
Both EF and PF	2 (1.6%)
Nothing	20 (16%)
Energy prescription (kcal/d)	2043.9±304.3
Protein prescription (g/d)	81.6 (72-90)
Mean energy intake (kcal/d)	534.9, 361.4 (101.07-960.6)†
Mean protein intake (g/d)	20.6, 16 (4.4-36.5)†
Mean carbohydrate intake (g/d)	18.1 (3.7-123.4)
Mean fat intake (g/d)	19.7 (5.2-38.2)
Adequacy of calorie from nutrition therapy (%)	17.6 (5-47.7)
Adequacy of protein from nutrition therapy (%)	18.5 (5.1-43.9)

IQR: Interquartile range; ICU: Intensive care unit; EF: Enteral feeding; PF: Parenteral feeding; NPO: Nil per oral; SD: Standard deviation; †These continuous data with skewed distribution are expressed as mean, median (IQR)

in the hospital for 27.4 days. The mean ventilator independency for the patients was recorded at 6.9 days. Table 2 also demonstrates mortality during ICU and hospital stays. The patients' nutritional prescription and nutritional intake are depicted in table 2. The majority of the patients received enteral feeding and 16% of them didn't receive any form of feeding for the entire period of stay in the ICU. Among all the patients, the average time to the commencement of enteral feeding was 4.27 days. Overall, the patients received 26.26% of their energy and 26.48% of their protein prescription from their enteral/parenteral nutrition or both.

The anthropometric measurements on ICU admission and discharge days are listed in table 3. The mean values of the estimated current weight, MUAC, TSF, MAMC, and calf circumference decreased significantly during the patients' stay in the ICU. The mean BMI did not change significantly, but a declining trend on discharge day compared to admission day was visible.

The results of body composition measurements are also shown in table 3. The average lean mass weight and body cell mass decreased significantly on discharge day. Fat mass weight and dry lean mass did not show significant changes in the period of study; however, a slight reduction was recorded in dry lean mass. Table 3 summarizes the biochemical measurements. Total protein, albumin, pre-albumin, total lymphocyte count, calcium, and phosphorus did not change significantly during the patients' stay in the ICU. The magnesium level had a significant decrease on discharge day.

The distribution of SGA in the patients significantly changed during their ICU stay. Malnutrition deteriorated as the patients stayed longer in the ICU. Malnutrition (scores B and C) was observed in 28.8% of the patients on admission day, while it increased to 58.62% on discharge day (table 3).

The malnutrition scores on ICU discharge day correlated inversely and significantly with the patients' BMI, MUAC, TSF, MAMC, calf circumference, and dry lean mass on admission day. However, they did not correlate with the biochemical data (table 4).

Positive significant correlations were observed between malnutrition on discharge day and the length of ICU stay, days delayed from ICU admission to the commencement of enteral feeding, and number of days without enteral feeding in the ICU. There was no significant

Table 3: Anthropometric and biochemical measurements of the patients on ICU admission and discharge days

Measurements	Mean±SD, median (IQR)		P value
	Admission day	Discharge day	
Weight (kg)	73.4±12.7	66.6±11.6	<0.001‡
BMI (kg/m²)	25.7 (23.3-28.8)	22.8 (21.3-26.5)	0.088
MUAC (cm)	30.1±4.5	27.6±4	<0.001‡
TSF (mm)	14.5±6.2	11.2±5.4	<0.001‡
MAMC (cm)	25.5±3.5	24±3.3	<0.001‡
Calf circumference (cm)	32.2±3.8	29.1±3.7	<0.001‡
Fat mass weight (kg)	12.6 (8.5-19.5)	14 (6.8-21.2)	0.968
Lean mass weight (kg)	59.1±15.3	52.3±11.3	<0.001‡
Body cell mass (kg)	34.2±8.3	28.9±7.3	<0.001‡
Dry lean mass (kg)	12.4 (9.1-17.1)	10.8 (7-14.6)	0.059
SGA (n, %)†			<0.001‡
A	89 (71.2%)	36 (41.37%)	
B	33 (26.4%)	34 (39.08%)	
C	3 (2.4%)	17 (19.54%)	
Total protein (g/dL)	6±1.05	6.2±1	0.968
Albumin (g/dL)	3.4±0.6	3.3±0.6	0.16
Pre-albumin (mg/dL)	19.5 (13.9-24.6)	19.3 (13.9-29.7)	0.227
TLC	1242.5 (787.6-2099)	1279.2 (1042-1699)	0.146
Mg (mg/dL)	2.2±1.2	2±0.4	0.013‡
P (mg/dL)	3.5±1.2	3.3±0.7	0.72
Ca (mg/dL)	8.4±0.67	8.5±0.6	0.43

BMI: Body mass index; MUAC: Mid-upper-arm circumference; TSF: Triceps skinfold thickness; MAMC: Mid-arm muscle circumference; SGA: Subjective Global Assessment; TLC: Total lymphocyte count; Mg: Magnesium; P: Phosphorous; Ca: Calcium; EF: Enteral feeding; SD: Standard deviation; IQR: Interquartile range; †SGA of the patients who died on the last day were not recorded; ‡P≤0.05 was considered statistically significant

correlation between the level of malnutrition on discharge day and the number of ventilator-free days in the ICU (table 4).

A hierarchical multiple regression was used to assess the ability of the mean calorie and protein intakes during ICU stay to predict malnutrition on discharge day, after controlling for the length of ICU stay. The length of ICU stay was entered at step 1 and explained 9.9% of the variance in malnutrition on discharge day. After the entry of the mean calorie and protein intakes at step 2, the total variance explained by the model as a whole was 10.2%, F (3, 83), and P=0.029. In the final model, only the length of ICU stay was statistically significant (β=0.38, P=0.026), while the mean caloric intake (β=-0.123, P=0.726) and the mean protein intake (β=0.037, P=0.917) were not significant.

Discussion

Malnutrition is associated with an increased risk of mortality and morbidity during patients' ICU stay.[16,17] The nutritional assessment of these patients is, therefore, of great significance, although it is very difficult to perform due to the volume of resuscitation. Our results showed a significant increment in the prevalence of malnutrition among the critically ill patients on ICU discharge day (58.62%) compared to ICU admission day (28.8%) according to the SGA questionnaire. There is a paucity of data in the existing literature on the prevalence of malnutrition in critically ill patients on ICU discharge day, but previous research showed that the rate of malnutrition on ICU admission day was between about 30 and 50%.[2,18] Norman et al.[19] reported a 20 to 50%rate of hospital-related malnutrition in their patients, while Hosseini et al.[20] reported a rate of 12.3% for malnutrition on hospital discharge day compared to 6.3% on admission day. The different prevalence rates of malnutrition can be explained by the use of different nutritional indicators and disease severity, degree of disability, and complexity of treatment in study populations.[2] The performance of medical teams can also affect malnutrition prevalence.

In the present study, inadequate energy intake compared to requirement could be the main reason in the increase in malnutrition during ICU stay. Although our results showed a nonsignificant relationship between malnutrition on ICU discharge day and the mean caloric intake after controlling for the length of ICU stay, inadequate intake was notable due to clinical reasons. Inadequate intakes of energy

Table 4: Correlation between the SGA status on ICU discharge day and nutritional indicators on admission day and outcomes

Measurements on admission day	Correlation coefficient (Rho Spearman)	P value
Weight (kg)	−0.412	<0.001†
BMI (kg/m²)	−0.426	<0.001†
MUAC (cm)	−0.459	<0.001†
TSF (mm)	−0.514	<0.001†
MAMC (cm)	−0.247	0.021†
Calf circumference (cm)	−0.481	<0.001†
Fat mass weight (kg)	−0.178	0.118
Lean mass weight (kg)	−0.144	0.211
Body cell mass (kg)	−0.136	0.255
Dry lean mass (kg)	−0.289	0.01†
Total protein (g/dL)	0.106	0.334
Albumin (g/dL)	0.132	0.221
Pre-albumin (mg/dL)	−0.09	0.407
TLC	−0.127	0.244
Mg (meq/L)	−0.059	0.622
P (mg/dL)	−0.021	0.852
Ca (mg/dL)	−0.179	0.062
Length of ICU stay (d)	0.328	0.002†
Length of ventilator-free days	0.288	0.11
Days from ICU admission to EF	0.321	0.002†
Number of days without EF	0.206	0.05†

BMI: Body mass index; MUAC: Mid-upper-arm circumference; TSF: Triceps skinfold thickness; MAMC: Mid-arm muscle circumference; SGA: Subjective Global Assessment; TLC: Total lymphocyte count; Mg: Magnesium; P: Phosphorous; Ca: Calcium; EF: Enteral feeding. †P≤0.05 was considered statistically significant

and macronutrients, especially protein, together with increased dietary requirements and also dietary losses constituted the strong predictors of malnutrition among our patients in the ICU. Inflammation and immobilization are also important and may play roles in accelerating malnutrition in the ICU.[19] The American Society of Parenteral and Enteral Nutrition (ASPEN) determined 50-65% of feeding goal as the cutoff point for energy intake in critically ill patients.[21] In this respect, most of the studies conducted hitherto have reported correlations between negative energy balance and adverse clinical outcomes in patients in the ICU.[22-24] Villet et al.[25] also reported a strong correlation between inadequate feeding and increased incidence of ICU complications.

In addition, the delay in enteral feeding and the number of days without enteral feeding in the ICU correlate significantly with the severity of malnutrition. The European Society of Parenteral and Enteral Nutrition (ESPEN) recommended enteral feeding as early as less than 24 hours of patient admission to critically ill care units.[14] In the current study, the average time to the commencement of enteral feeding in the patients who received feeding was 4.27 days and16% of the entire study population did not receive any type of feeding while staying in the ICU. All of these alongside the prolongations of ICU stay could be a considerable reason for malnutrition on discharge day in the current study. Kim et al.[26] reported prolonged interruption of enteral feeding and under-prescription of energy as the causes of underfeeding malnutrition in their critically ill patients. Most of the previous studies also showed that an early initiation of enteral feeding was associated with an increased energy intake,[27,28] as a main preventive factor for severe malnutrition.

Our detailed assessment of the patients in the ICU indicated that mean weight, MUAC, TSF, MAMC, and calf circumference decreased significantly during their ICU stay. These findings are in agreement with those reported by Nematy et al.[29] (2011), who showed a significant decrease in weight and TSF among their patients in the ICU. A reduction in anthropometric measurements in patients staying in the ICU was also shown in a study by Huang et al.[8] In addition, Sungurtekin et al.[1] (2008) demonstrated low levels of weight, BMI, MUAC, and TSF in the malnourished compared to the well-nourished critically ill patients in their investigation.

In the current study, a significant drop in lean mass weight and body cell mass was detected in the patients on the day of discharge, while no significant change was observed in the patients' fat mass. A declining trend in the patients' dry lean mass was also seen during their ICU stay. These findings are consistent with those reported by Fuentes et al.[30] (2009), who demonstrated a decrease in their patients' muscle mass and an increase in fat mass during the first 7days after ICU admission. Using bioelectrical impedance analysis (BIA), Nematy et al.[29] reported no significant changes in their patients' fat and lean mass during ICU stay. BIA-derived body cell mass also decreased in the ventilator-dependent patients compared to an increment in fat mass in a study performed by Faisy et al.[31] Although BIA is not considered the best method to measure the body composition in patients in the ICU because of their water and electrolyte imbalances, Robert et al.[32] recommended it as an easy adjunctive method to oversee the nutritional status of patients.

A possible explanation for the drop in our patients' lean body mass during their ICU stay may be, in part, an increase in inflammation since it helps accelerate the degradation of muscle proteins.[33-35] Immobilization is another important

factor in muscle myopathy among hospitalized patients.[33] The decrease in body cell mass can be explained by the inadequate intake of energy and protein in our patients.[32] The clinical consequences of all these factors will result in host defense deterioration, prolonged length of ICU stay, and ventilator dependency.[17]

The evaluation of the biochemical data revealed a significant decrease in our patients' serum magnesium concentration during their ICU stay. Magnesium deficiency is common among patients during their stay in the ICU.[36,37] Previous studies reported hypomagnesemia as a predictor of disease severity and mortality in critically ill patients.[38,39] Malnutrition and inadequate dietary magnesium intake are regarded as the main reasons for magnesium depletion in hospitalized patients.[37] In the current study, inadequate intake of calorie and protein and the consequent malnutrition can be related to a decreased level of magnesium.

By comparing biochemical data and anthropometric measurements, the present study showed that anthropometric measurements were a better predictor of the nutritional outcome (severity of malnutrition) of our critically ill patients. In this regard, Sungurtekin et al.[1] revealed a reverse significant relationship between anthropometric measurements and SGA on the admission day of their patients to the ICU. In contrast to our study, however, the authors reported a significant correlation between albumin level and SGA. The peculiarities of albumin metabolism affect the interest in that for assessing nutritional status in critically ill patients.[40] Thus, anthropometric measurements constitute a noninvasive, cost-effective, and rapid way to evaluate the nutritional status of patients in the ICU.

The limitation to the present study is that we recruited heterogeneous ICU patients with different medical or surgical problems. It is preferable to study one group of patients in detail. However, we studied mixed ICU patients intentionally because one of the aims of this study was to find the prevalence of malnutrition on ICU admission and discharge days regardless of etiology.

Conclusion

Malnutrition on ICU discharge day increased to 58.62% in our patients according to the SGA questionnaire. Detailed assessment showed a significant reduction in the patients' lean body mass compared to their fat mass. Anthropometric measurements were better predictors of the nutritional outcome of our critically ill patients than were biochemical tests. The delay in enteral feeding had a direct effect on malnutrition severity on discharge day. Therefore, nutritional assessment with emphasis on anthropometric measurements and SGA should be routinely performed on ICU admission and stay in an attempt to reduce nutrition-related complications and to implement timely nutritional intervention.

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