Original Article

Nutritional status association with protein-calorie adequacy in critically ill patients admitted to an intensive care unit

Associação do estado nutricional com a adequação proteico-calórica em pacientes críticos internados em uma unidade de terapia intensiva

DOI: 10.37111/braspenj.2023.38.4.01

Ellen Cristina Pawluk[1]
Dalton Luiz Schiessel[2]
Heloisa de Oliveira Ribas[3]
Nancy Sayuri Uchida[4]
Karolyne Kruger Carvalho Eing[4]
Vania Schmitt[5]

ABSTRACT

Introduction: The association between nutritional status and protein-calorie adequacy in critically ill patients hospitalized in an intensive care unit was evaluated, using exclusive enteral nutritional therapy. **Methods:** Cross-sectional study of quantitative nature, carried out in a hospital intensive care unit in Guarapuava, PR, Brazil. Patients over 18 years old, of both sexes, on exclusive enteral nutrition therapy were included. Evaluation took place in the first 24 hours and after 72 hours of starting nutritional therapy. To assess nutritional status, body mass index, calf circumference classification, tetrapolar electrical bioimpedance and biochemical tests were used. In the assessment of protein-caloric adequacy, collections of the prescribed and administered volume were used. Descriptive statistics tests were performed using means, standard deviation, and relative and absolute frequencies in the SPSS version 25. **Results:** The sample consisted of 16 patients, with a mean age of 56.5±17.3. Most (75%) patients were men. According to BMI, 50% presented eutrophy, and, according to calf circumference, 68.8% presented muscle mass loss. There was no statistical difference in the analysis of body composition and phase angle between 24 and 72 hours. The nutritional recommendation needs of caloric adequacy of ≥80% were achieved by two patients, and for protein adequacy, only 3 reached the milestone of ≥80%. **Conclusion:** Although the correlations do not show a direct association with clinical outcome, it is concluded that protein-caloric inadequacy leads to a worsening in patients' general condition, increasing chances of developing malnutrition, negatively influencing hospital clinical outcome.

Keywords:
Enteral nutrition. Nutritional status. Energy need. Intensive care units. Critical care. Anthropometry.

Unitermos:
Nutrição enteral. Estado nutricional. Necessidade energética. Unidades de terapia intensiva. Cuidados críticos. Antropometria.

Address for correspondence:
Dalton Luiz Schiessel
Department of Nutrition, Midwest State University – Alameda Elio Antonio Dalla Vecchia, 838 – Vila Carli – Guarapuava, PR, Brazil – Zip code: 85040-167
E-mail: daltonls68@gmail.com

Submission:
October 5, 2023

Accepted for publication:
December 8, 2023

RESUMO

Introdução: A associação do estado nutricional com a adequação proteico-calórica de pacientes críticos internados em uma unidade de terapia intensiva foi avaliada, usando terapia nutricional enteral exclusiva. **Método:** Estudo transversal de natureza quantitativa realizado em uma unidade de terapia intensiva de um hospital de Guarapuava, PR, Brasil. Foram incluídos pacientes acima de 18 anos, de ambos os sexos, em terapia de nutrição enteral exclusiva. A avaliação ocorreu nas primeiras 24 horas e após 72 horas de início da terapia nutricional. Para avaliação do estado nutricional, utilizou-se o índice de massa corporal (IMC), classificação da circunferência da panturrilha, bioimpedância elétrica tetrapolar e exames bioquímicos. Na avaliação da adequação proteico-calórica, utilizou-se coletas do volume prescrito e administrado. Foram realizados testes de estatística descritiva, com a utilização de médias, desvio padrão e frequências relativas e absolutas no programa *Statistical Package for Social Science* 25. **Resultados:** A amostra tinha 16 pacientes, com média de idade de 56,5±17,31. Os pacientes eram majoritariamente homens (75%). Segundo o IMC, 50% dos pacientes apresentou eutrofia, e pela circunferência da panturrilha, 68,8% dos pacientes apresentaram perda de massa muscular. Não houve diferença estatística na análise da composição corporal e ângulo de fase entre as 24 e 72 horas. A adequação calórica ≥80% foi atingida por dois pacientes, e para adequação proteica, apenas 3 alcançaram a meta de ≥80%. **Conclusão:** Apesar das correlações não demonstrarem associação direta com o desfecho clínico, conclui-se que a inadequação proteico-calórica induz a piora no estado geral dos pacientes, promovendo maiores chances de desenvolver desnutrição hospitalar negativamente influenciando o desfecho clínico.

1. Registered Dietitian, Graduated in Nutrition at Midwest State University (UNICENTRO), Guarapuava, PR, Brazil.
2. PhD, Associated Professor at the Nutrition Department, Health Science Center, Campus CEDETEG, Midwest State University (UNICENTRO), Guarapuava, PR, Brazil.
3. Registered Dietitian, Hospital de Caridade São Vicente de Paulo, Guarapuava, PR, Brazil.
4. PhD, Professor at the Nutrition Department, Health Science Center, Campus CEDETEG, Midwest State University (UNICENTRO), Guarapuava, PR, Brazil.
5. PhD Candidate, Professor at the Nutrition Department, Health Science Center, Campus CEDETEG, Midwest State University (UNICENTRO), Guarapuava, PR, Brazil.

INTRODUCTION

Adequate nutrition is essential for maintenance and recovery of hospital patients. Malnutrition is a very prevalent multifactorial clinical condition, especially in the intensive care unit (ICU). It may be present before admission and/or be developed in the hospital, even in cases where the patient is well nourished at the admission time. Malnutrition can occur for reasons such as infection complications, length of stay, lack of appetite, hypercatabolism and inadequate energy intake[1,2]. The consequences of malnutrition are important, as they lead to an increase in hospitalization time, hospital costs, morbidity, and mortality[3].

Critical patients are hemodynamically unstable and need immediate care and adequate caloric-protein supply, due to the high neuroendocrine inflammatory response, hypermetabolism and catabolic stress. These processes induce energy-protein malnutrition, by depleting muscle and adipose tissue mass, which leads to increased length of stay and mortality rates[2,4,5].

Enteral nutritional therapy (ENT) is often used to support the energetic needs of these patients, reducing disease severity in those who are unable to eat orally. ENT is preferred because it is the second, more physiological route to nutrition[6,7]. It is essential for patient recovery, maintaining the nutritional status, lowering infection complications, balancing the immune system and preventing malnutrition. However, the ENT must be constantly monitored, offering macro and micronutrients according to the needs of each patient and giving prioritizing adequate protein supply[4,8].

According to the European Society for Clinical Nutrition and Metabolism (ESPEN), an adequate supply of ENT must be performed early. It needs to be administered within 48 hours of hospitalization[9], and for ENT administration to be satisfactory, a protein-caloric adequacy of 80% or more must be achieved[10].

It is important to emphasize that the nutritional status assessment of critically ill patients is essential to define their protein caloric needs. However, there are no gold standard methods for this assessment. Because of this, it is feasible to use all available methods, allowing greater reliability at the time of the nutritional evaluation[8].

Body composition analysis by bioelectrical impedance (BIA), dual-energy absorptiometry (DEXA), computed tomography (CT) and magnetic resonance imaging (MRI) are recommended to evaluate patients. However, there are more accessible alternatives, such as the physical examination, standard anthropometric measurements (muscle circumference, arm circumference and calf circumference), and handgrip strength. Biochemical methods can be used as biomarkers of malnutrition, such as C-reactive protein (CRP) and creatinine tests, used in chronic diseases related to inflammation, and to detect catabolism[9].

Thus, the aim of this study was evaluating the association between nutritional status and protein-calorie adequacy of critically ill patients admitted to an intensive care unit, using exclusive enteral nutritional therapy.

METHODS

This is a cross-sectional, observational, quantitative study, carried out between August of 2022 and March of 2023. The study was conducted at the São Vicente de Paula Charity Hospital (HSVP), located in the city of Guarapuava, PR, Brazil. It is a reference hospital for 20 municipalities in the region. With prior authorization, this study was approved by Research Ethics Committee, COMEP-UNICENTRO (number 4,289,047).

For participation in the experiment, we had patients of both sexes, over 18 years old, with different pathologies and nutritional needs, and who signed the Free and Informed Consent Form (FICF) before the evaluation. For unconscious patients, the FICF was signed by the responsible family member. We excluded patients who underwent ENT in conjunction with oral feeding, patients unable to undergo the bioelectrical impedance test, pregnant women and those who did not sign the FICF.

Collection time was defined by the patients' stay analysis at the hospital, so that we could carry out evaluations at different times. Therefore, the assessment was initially performed within 24 hours of the ENT start and after 72 hours.

Due to difficulty in walking or decrease level of consciousness (DLC), measures were taken to apply formulas for weight and estimated height. Therefore, knee height (KH) was measured with the aid of a wooden anthropometric ruler, and we took measurements of arm circumference (AC), wrist circumference (WC) and calf circumference (CC) with a 2-meter inelastic soft ruler tape.

To stipulate the current weight (in kilograms), formulas by Ross Laboratories[11] were used. For women, body weight was equal to (KH x 1.01) + (AC x 2.81) – 66.04. For men, body weight was equal (KH x 1.19) + (AC x 3.21) – 86.82. To calculate height, we used the calculations by Chumlea et al. (1994)[12]. For women, height was equal to 70.25 + (1.87 x KH) – (0.06 x age), while the height for men was equal to 71.85 + (1.88 x KH).

Body mass index (BMI) was calculated from the estimated height and weight, dividing weight (kg) by height square (m2). We classified the BMI according to the WHO guidelines[13].

Body composition was assessed using tetrapolar electrical bioimpedance (RJL Systems model Quantum IV®, Clinton, Ohio, United States), which provided raw data for resistance, reactance, impedance and phase angle. The standardized phase angle (SPA) was calculated according to the formula: [(observed FA – mean FA for gender and age) / standard deviation of FA for gender and age]. We classified the obtained valued by referencing parameters for age and gender according to Barbosa-Silva (2005)[14].

We also used a software (RJL Systems, Clinton, Ohio, United States) to obtain fat mass weight (FM), lean mass weight (LM), and % body fat and total body water[15]. We excluded data from 3 patients whose bioimpedance test result was not consistent with the range of resistance and reactance values. The SPA obtained through the bioimpedance test was used to compare the individuals, even in the two collection periods.

Percentage body fat for sex and age was classified according to Pollock & Wilmore (1993)[16]. Body fat was evaluated as excellent, average, below average, above average, poor and very poor.

To establish the protein requirement of each patient, the amount recommended for each clinical condition was used[17]. Basal metabolic rate (BMR) and total energy expenditure were calculated using the Harris & Benedict formula (1918)[18], multiplying factors for activity, injury and thermal BMR.

Patients using ENT underwent an evolution protocol during the evaluation period, ranging from 15 ml/hour on the first day, 30 ml/hour on the second day and 45 ml/hour on the third day. These values were prescribed by the responsible nutritionist, who establishes the recommended evolution volume for each patient. To consider caloric and protein quota achieved, the adequacy equal or above 80% proposed by Ribeiro (2015)[10] was used.

Biochemical tests used for analysis were from moment of patient's admission, obtained through electronic medical records.

Data were analyzed using descriptive statistics, using means, standard deviations (SD) and relative and absolute frequencies. Descriptive values were expressed as mean±SD. All p-values were two-sided. We established significance levels of ≤0.05. A Kolmogorov-Smirnov was performed to verify the normality distribution of numeric variables. Numerical variables comparison for related samples and parametric values was performed using the T-student test. The Wilcoxon test was used for non-parametric variables. Analyzes were performed using the Statistical Package for Social Sciences (SPSS), version 25.0 (IBM Corporation, Armonk, New York, USA).

RESULTS

The sample consisted of 16 patients, with a mean age of 56.5±17.3 (ages of 24 to 86). Out of all patients, 12 (75.0%) were male. Patients were hospitalized with different diagnoses, with a higher prevalence of stroke (50%), followed by cancer (12.5%), and other comorbidities (37.5%). Administration of enteral feeding to tube position was given via nasoenteric route. For the outcome, most patients were discharged 8 (50.0%) and there were 7 deaths (43.8%).

Patients nutritional profile is shown in Table 1. Weight and BMI did not vary between the first and second data collection. Weight for the first and second data collection were 67.3±17.6 kg and 67.5±16.6 kg, respectively. BMI for the first and second data collection were 23.8±5.8 kg/m^2 and 23.9±5.5 kg/m^2 respectively. Mean height among patients was 168.6±5.2 cm.

Most of the patients (81.3%) had absent bowel habits, some patients (12.5%) had regular bowel movement, and 1 (6.3%) had diarrhea. After the second evaluation, most of the patients with absent bowel habits started to have constipation (75%).

When classified by the CC, the majority (81.3%) of patients presented muscle mass loss. The mean of the first and second CC assessment was 32.9±4.2cm and 33.1±3.7cm, respectively.

Table 1 – Nutritional status profile of hospitalized patients receiving enteral nutrition therapy in a hospital in Guarapuava, PR, Brazil.

Variable	Classification	24 hours, n(%)	72 hours, n(%)
BMI	Underweight	3 (18.8)	3 (18.8)
	Normal weight	8 (50.0)	8 (50.0)
	Overweight/Obesity	5 (31.3)	5 (31.3)
Bowel habit	Absent	13 (81.3)	-
	Regular	2 (12.5)	3 (18.8)
	Constipation	-	12 (75.0)
	Diarrhea	1 (6.3)	1 (6.3)
CC Classification	Normal	5 (31.3)	3 (18.8)
	Muscle mass loss	11 (68.8)	13 (81.3)
Stress diagnosis	Low	2 (12.5)	-
	High	14 (87.5)	-

BMI: body mass index; CC: calf circumference.

Table 2 characterizes the patients' biochemical profile at admission. All patients had higher than recommended values for CRP exams. However, 62.5% patients presented urea content above the recommended value. The number of patients with higher than recommended values of creatinine were lower (43.8%). The average values were 12.3±9.3 mg/dl for CRP, 52.6±22.6 mg/dl for urea, and 1.2±0.6 mg/dl for creatinine.

The body composition variables had no relation to fat body mass, skeletal muscle mass, intra and extracellular water, and SPA (Table 3). That was true for both evaluations ($p_{body\ mass}$= 0.298; $p_{skeletal\ muscle}$=0.443; $p_{intra\ water}$=0.731; $p_{extra\ water}$=0.311; p_{SPA}=0.600). The mean body fat was 16.8±8.7 kg in the first assessment and 16.4±9.1 kg in the second assessment.

In the first assessment of 13 patients with the analyzed body composition, 3 presented SPA changes from normal to reduced, while 2 presented SPA changes from reduced to normal.

Figure 1 shows the patients' caloric adequacy trajectory during ENT evolution. Only two patients reached the estimated caloric quota of ≥80%. The maximum percentage reached was 85%, by one of the patients on the third day, and by another patient who obtained their adequacy in the three days.

We observed that low percentages of protein adequacy were more frequent, and only 4 patients reached the estimated quota of ≥80%. The maximum percentage reached on the first day was 80%. On the second day, it was 73.6%, and in the third day, it was 88.6% (Figure 2).

Table 2 – Biochemical profile in patients receiving enteral nutrition therapy in a hospital in Guarapuava, PR, Brazil.

Variable	Classification	N	%
Hemoglobin	Below recommended	7	43.8
	Normal	7	43.8
	Above recommended	2	12.5
Hematocrit	Below recommended	5	37.5
	Normal	7	43.8
	Above recommended	3	18.8
Leucocytes	Below recommended	0	-
	Normal	9	56.3
	Above recommended	7	43.8
CRP	Below recommended	0	-
	Normal	0	-
	Above recommended	15	100
Urea	Below recommended	0	-
	Normal	6	37.5
	Above recommended	10	62.5
Creatinine	Below recommended	4	25.0
	Normal	5	31.3
	Above recommended	7	43.8

CRP: C-reactive protein.

Table 3 – Biochemical profile in patients receiving enteral nutrition therapy in a hospital in Guarapuava, PR, Brazil.

Evaluated Measures (mean±SD)	24 hours	72 hours	p-value
Fat body mass (%)	23.61±6.74	22.91±7.70	0.298
Skeletal muscle mass (kg)	23.46±7.63	21.60±8.34	0.443
Intracellular water (kg)	21.79±4.94	22.25±6.30	0.731
Extracellular water (kg)	17.70±5.07	18.90±5.82	0.311
SFA	-0.53±3.32	-1.31±4.03	0.600

%: percentage; kg: kilograms; SPA: standardized phase angle; SD: standard deviation.

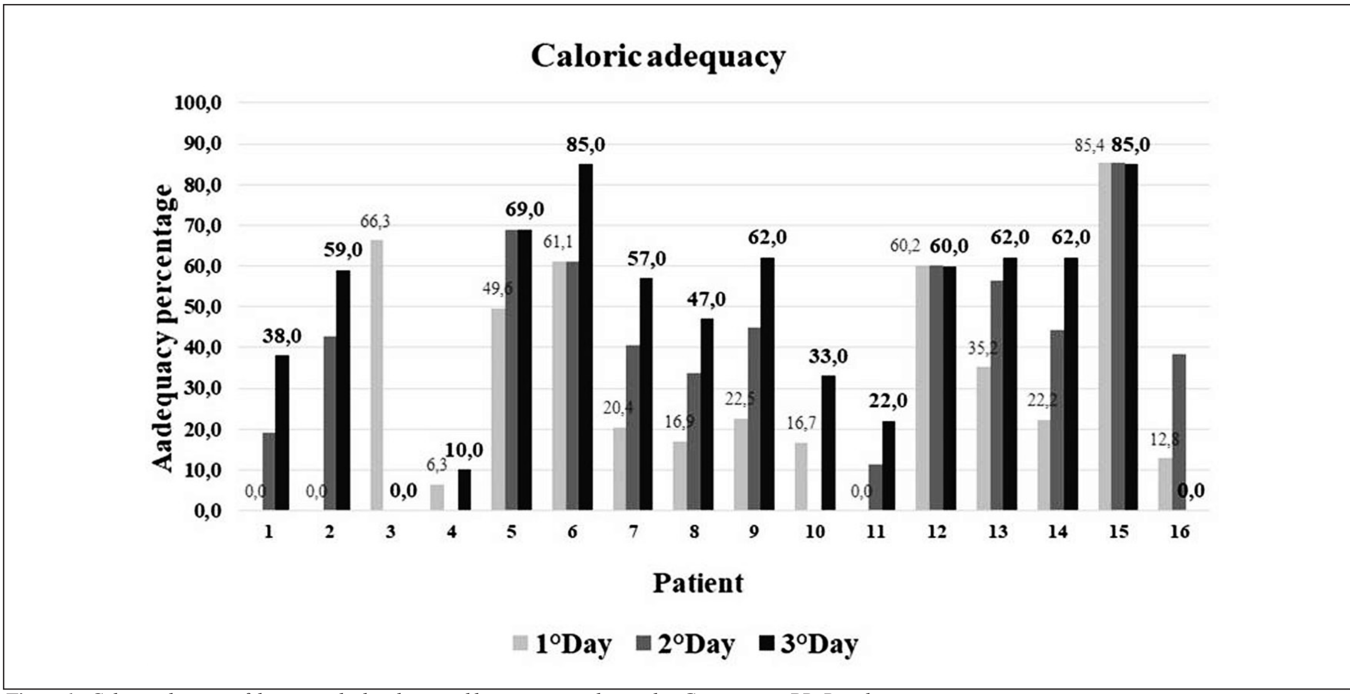

***Figure 1 -** Caloric adequacy of diet prescribed and ingested by patients in a hospital in Guarapuava, PR, Brazil.*

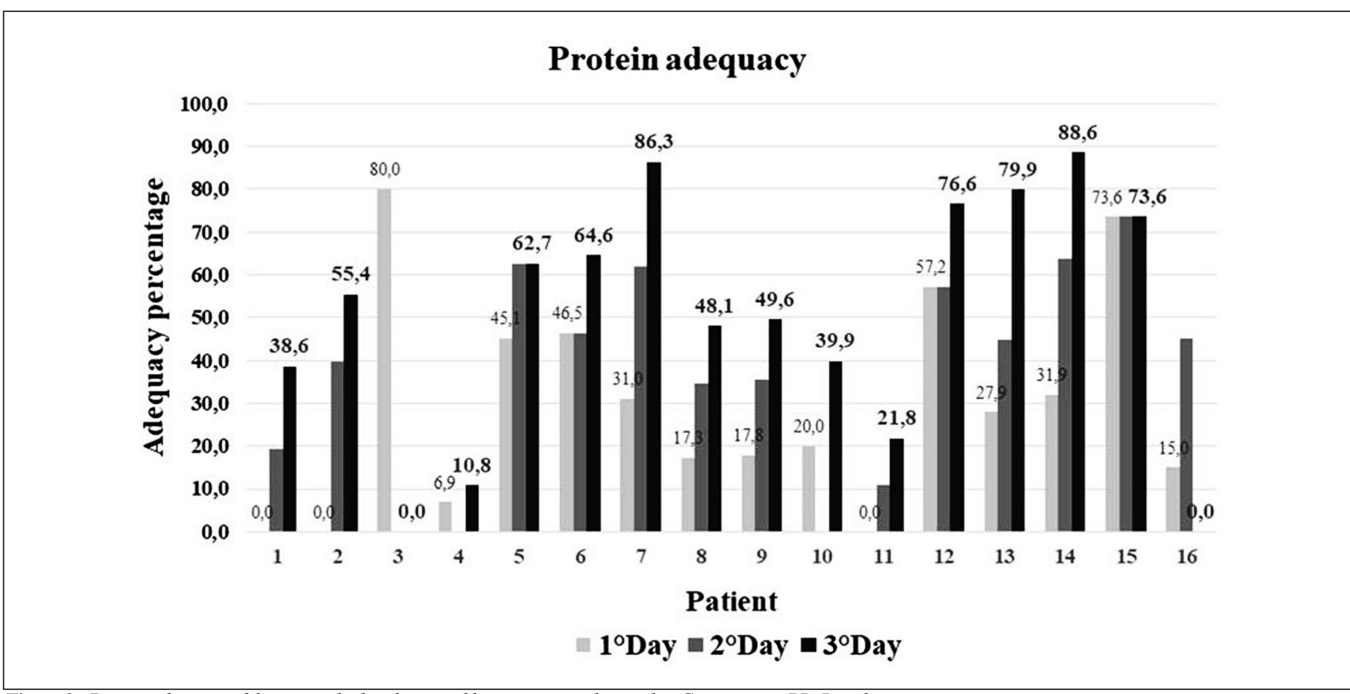

***Figure 2 -** Protein adequacy of diet prescribed and ingested by patients in a hospital in Guarapuava, PR, Brazil.*

DISCUSSION

The different diagnoses found in this study were related to the hospital, as it is a reference center, dealing with specialties in cardiology, neurology, high-risk pregnancy, and oncology. Cerebral vascular accident (CVA) is a neurological disease responsible for most hospitalizations in hospital environments, a result also found by another study, where the hospitalization prevalence for neurological diseases was predominant (31.0%) in relation to other comorbidities[6].

Among male individuals, there was a greater predominance of hospitalization time, contributing to greater data collection for males. A similar result was found in another study, where most patients using ENT were male (58.7%)[19]. This can be explained by the low demand for health services among men, due to feelings of diagnosis fear, shame due to the false idea of not being prone to acquiring diseases, impatience in relation to health services organization, and delay in care. These factors are also influenced by sociodemographic characteristics and lifestyle, including alcoholism, residence location, and education level[20].

Critical patients often have gastrointestinal problems and constipation. This is commonly caused by medication such as vasoactive drugs, enteral diets with low fiber supply, and/or electrolyte imbalance. These problems should be avoided, as the prevention of intestinal constipation avoids local irritation and lowers perforation risk. These conditions could lead to longer hospital stays, increased mortality, and intolerance to enteral nutrition[3,21].

There was a prevalence of constipation in the second data collection. Similarly, a study described the high intestinal complications preponderance in patients admitted to the ICU (81.1%)[21]. This can be explained due to the intestinal microbiota modulation by ENT. The treatment for intestinal imbalances is based on the use of soluble fiber, for critically ill patients who have diarrhea, and insoluble fiber, for those with constipation. It is up to the responsible team to decide the best approach for each complication[22].

According to data available in a survey with 4000 hospitalized patients, 48% of these had malnutrition[23]. Critically ill patients are prone to develop muscle mass depletion due to intense inflammatory and metabolic response to stress. In another study, 87.5% of patients presented high stress[24], which could explain the 68.8% who presented muscle mass loss due to CC in the second evaluation. However, according to BMI, most patients were eutrophic. A similar result was found in another study, that evaluated the protein adequacy of 188 critically ill patients. Here, 54.8% of the sample was classified as eutrophic[4].

In this study, entire sample showed CRP values above the recommended, in line with the results found in another survey[25]. However, in a study that evaluated 130 patients for 7 days, a negative relationship between CRP and infused volume was observed[10]. This could suggest that the metabolic alterations of the systemic evaluation would lead patients to tolerate smaller volumes of enteral nutrition, contributing for caloric inadequacy, a result that was not observed in this study. High CRP values tend to indicate neurological atrophy, which, in the long-term, influences clinical outcome, especially in those diagnosed with stroke[26], which many of the patients in our study had.

Creatinine is a renal function biomarker, derived from the creatine metabolism. Due to its origin in myocytes, it can be used to estimate muscle mass. In patients with critical illnesses, creatinine can increase or decrease, depending on the underlying disease. However, it can also be influenced by medications used in the ICU. Therefore, it should be observed as a complementary measure for assessing nutritional status, and not on an individual basis[27]. One study associated creatinine values below 0.6 mg/dl to a lower survival rate among hospitalized patients[27]. In our study, 25% of the sample presented creatinine levels below the recommended level (<0.6 mg/dl), and the majority of patients presented high values (43.8%). This indicates muscle catabolism. A similar study evaluated the nutritional status in 31 patients in an intensive care unit, where patients also had high creatinine values[8].

Our study also found high values of urea. This was similar to a result also found in one study that presented a high mean value of urea (72.9±45.3 mg/dl)[8], and another, which found that 19 out of 20 patients had values higher than recommended for serum urea (95%). Urea is used as an indicative measure of renal failure, and when below the recommended level, it tends to illustrate a lack of proteins in the body[29], but this measure can be induced by other factors not related to from renal function[8].

SPA is used as an indicative for people at high risk. Reduced SPA in critically ill patients is linked to an unfavorable prognosis[14]. It was observed that some patients (23.0%) started to present normal to reduced SPA in the second evaluation, which could indicate a worsening in these patients' prognosis.

Skeletal muscle mass, along with fat body mass, intra and extracellular water did not show significant changes after the second evaluation. This result shows that the collection time may be small for there to be noticeable differences in the enteral diet evolution. We found no papers that evaluated body composition of critically ill patients using ENT at different times, which limits the discussion on this subject.

In this study, the volume received from the enteral diet was evaluated for three days, and protein-caloric adequacy was verified during this time. Only two achieved caloric adequacies of ≥80% during the evaluation period. This should be monitored, especially in critically ill patients admitted to the ICU, as studies point that better caloric adequacies lead to better adherence to ENT, lower mortality rates, and shorter hospitalization periods[4,8]. It also prevents declines in the immune response, changes in body composition, and malnutrition. Another study observed that early ENT in critically ill patients increased the chance of hospital discharge by 1.22 times[30]. The same benefit was also reported by another study, because ENT minimizes malnutrition, consequently avoiding complications during hospitalization[9]. It is useful to characterize early ENT as the one administered within the first 24 to 48 hours of hospitalization. In the unit where our research was carried out, there are no protocols that require early ENT. However, authors suggest that it is a necessary practice, especially in patients with malnutrition, as this helps avoiding further reductions in nutritional status[30,31]. Despite that, a recent meta-analysis did not indicate a decrease in hospitalization time in the ICU, time under mechanical ventilation or mortality rate among patients who had a caloric adequacy of ≥70%[32]. Considering that most patients did not receive early ENT (56.25%), clinical outcome may not be associated with the initial time of diet administration.

Furthermore, in relation to the caloric adequacy assessment, similar studies obtained positive results for adequacy. Achieving an adequacy of >80% was associated to shorter hospital stays[6,7]. However, inadequacies found in this study corroborate a finding where, out of a total 1,122 patients, 646 presented caloric inadequacy[33].

In the study carried out with critically ill patients, the early use of ENT indicated an increase in dietary tolerance, with a prescribed volume exceeding 70%[31]. However, we did not find the same result along the diet evolution process, indicating less adherence to ENT in the long term, which could lead to a worsening in patient's general condition[31].

Regarding protein inadequacy, considering the first day, only 1 patient reached the 80% recommendation. In the second day, no patient reached the recommendation value, reaching the maximum percentage of 73.6%. Finally, on the third day, 4 patients had adequacy ≥80%. Therefore, out of the 16 patients who received ENT, only 3 (18.7%) reached the recommendation within 72 hours. This result is similar to one study where 56.4% of the patients had insufficient adjustments[4]. Multidisciplinary teams should be more concerned with protein intake than with caloric intake, as receiving1.3 g/kg/day of protein can improve immune response among patients[9].

Low protein intake tends to negatively influence survival rate, increasing mortality and increasing chances of malnutrition. There is a recommendation for patients to reach recommended protein intake values within 72 hours[34]. However, this did not occur in this study. If necessary, enteral formulas should be supplemented to meet satisfactory proteins quantities, so that each patient can reach their estimated protein quota[8]. Although clinical outcome is not associated with protein-calorie adequacy, studies suggest that this inadequacy leads to a higher mortality rate and interferes with the chances of hospital discharge[2,8,34].

It is also known that factors may be associated with protein-calorie inadequacy, as hospitalized patients may need to fast for surgical procedures and examinations. They might also suffer from tube complications and gastrointestinal symptoms[2]. This highlights the importance of nutritionist participation in monitoring patients' diets and their position among the nursing team, so that they can help develop specific nutritional plans for critically ill patients. This will ensure that the proposed goal is achieved, avoiding periods of prolonged fasting and also allowing for individual meal plans.

This study has limitations, such as the time required to carry out the research and low turnover of patients using exclusive ENT, impacting the sample number.

CONCLUSION

Although correlative analyzes do not demonstrate a negative effect on body composition, it is concluded that protein-calorie inadequacy leads to worsening conditions in patients, promoting greater chances of developing hospital malnutrition, and, consequently, negatively influencing the clinical outcome. It was observed that nutritional assessment is essential for carrying out an accurate diagnosis of the nutritional status in critically ill patients and defining the correct caloric-protein supply, with the aim of avoiding or recovering malnourished patients. It is important to highlight the need to develop individual and adapted protocols for hospital service available, minimizing differences between the plans for caloric-protein supply and its implementation among critical patients, given the essentiality of nutritional support, and, if the nutrition support is not enough, its related complications.

REFERENCES

1. Flores CAO, Farias RL. Fatores de risco associados à desnutrição em pacientes hospitalizados: uma revisão de literatura. Rev REMECS. 2021;6(10):3–8.
2. Lopes RPL, Oliveira MS, Costa RM, Costa FA, Duarte ACS, Abreu VS, et al. Adequação calórico-proteica da terapia nutricional enteral em pacientes críticos. Rev Cient Esc Estadual Saude Publica de Goias "Candido Santiago". 2022;8(e80013):1–14.
3. Guerra TLS, Mendonça SS, Marshall NG. Incidência de constipação intestinal em uma unidade de terapia intensiva. Rev Bras Ter Intensiva. 2013;25(2):87–92.
4. Santos HVDD, Araújo IS. Impact of protein intake and nutritional status on the clinical outcome of critically ill patients. Rev Bras Ter Intensiva. 2019;31(2):210–6.
5. Silva DP, Carvalho NA, Barbosa LS. Adequação da terapia nutricional enteral, complicações gastrointestinais e intercorrências em pacientes críticos. R Assoc Bras Nutr. 2021;12(1):104–15.
6. Nunes AP, Zanchim MC, Kümpel DA, Rodrigues TP, Zanin J. Adequação calórico-proteica da terapia nutricional enteral em pacientes críticos de um hospital de alta complexidade do Rio Grande do Sul. BRASPEN J. 2018;33(2):116–21.
7. Jesus CA, Leite LO, Silva IC, Fatal LBS. Adequação calórico-proteica, nutrição enteral precoce e tempo de permanência de pacientes críticos em uma unidade de terapia intensiva. Braz J Hea Rev. 2021;4(2):7511–26.
8. Sousa DA, Almeida MAC, Santos RS, Silva CN, Duarte CTT. Avaliação do estado nutricional de pacientes em terapia nutricional enteral de uma unidade de terapia intensiva. Braz J Develop. 2020;6(7):47886–901.
9. Singer P, Blaser AR, Berger MM, Alhazzani W, Calder PC, Casaer MP, et al. ESPEN guideline on clinical nutrition in the intensive care unit. Clin Nutr. 2019;38(1):48–79.
10. Ribeiro LMK, Oliveira Filho RS, Caruso L, Lima PA, Damasceno NRT, Soriano FG. Adequação dos balanços energético e proteico na nutrição por via enteral em terapia intensiva: quais são os fatores limitantes? Rev Bras Ter Intensiva. 2014;26(2):155–62.

11. Cockram DB, Baumgartner RN. Evaluation of accuracy and reliability of calipers for measuring recumbent knee height in elderly people. Am J Clin Nutr. 1990;52(2):397–400.
12. Chumlea WC, Guo SS, Steinbaugh ML. Prediction of stature from knee height for black and white adults and children with application to mobility-impaired or handicapped persons. J Am Diet Assoc. 1994;94(12):1385-8.
13. World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO consultation on obesity. Geneva: World Health Organization; 2000.
14. Barbosa-Silva MCG, Barros AJD, Wang J, Heymsfield SB, Pierson Jr RN. Bioelectrical impedance analysis: population reference values for phase angle by age and sex. Am J Clin Nutr. 2005;82(1):49–52.
15. RJL Systems. Body Composition 4.0 User Guide [Internet]. Clinton Township: RJL Systems; 2015. Disponível em: https://2013.rjlsystems.com/wp-content/uploads/2015/03/BC4_manual.pdf.
16. Pollock ML. Exercícios na saúde e na doença : avaliação e prescrição para prevenção e reabilitação. 2a ed. Vol. 1. Rio de Janeiro: Medsi; 1993.
17. Garnes SDA, Bottoni A, Lasakosvitsch F, Bottoni A. Nutrition therapy: a new criterion for treatment of patients in diverse clinical and metabolic situations. Nutrition. 2018;51-52:13–9.
18. Harris JA, Benedict FG. A biometric study of human basal metabolism. Proc Natl Acad Sci USA. 1918;4(12):370–3.
19. Chapela SP, Martinez PI, Reberendo MJ, Llobera ND, Ernst G. Prevalencia de diarrea en pacientes adultos en terapia intensiva y su relación con las fórmulas enterales listas para utilizar. Rev Fac Cienc Med Cordoba. 2022;79(3):254–9.
20. Barbosa YO, Menezes LPL, Jesus Santos JM de, Cunha JO da, Albuquerque TIP, Araújo D da C, et al. Factors associated with reasons for men not seeking primary health care services. Mundo Saude. 2019;43(3):666–79.
21. Oliveira ATV, Gomes RS, Monteiro AL, Galvão CEP, Bezerra GL, Cabral NAL. Constipação e diarreia em pacientes internados em unidades de terapia intensiva. JCS HU-UFPI. 2018;1(2):63–72.
22. Reis AM, Fruchtenicht AV, Loss SH, Moreira LF. Use of dietary fibers in enteral nutrition of critically ill patients: a systematic review. Rev Bras Ter Intensiva. 2018;30(3):358-65.
23. Waitzberg DL, Caiaffa WT, Correia MITD. Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. Nutrition. 2001;17(7-8):573–80.
24. Marques VGPS. Prevalência de desnutrição e hiperglicemia em pacientes críticos. Res Soc Dev. 2020;9(8):e72985226.
25. Santos IF, Soares BEAS, Nascimento RFS, Macedo MA, Costa PN, Araujo WA, et al. Perfil nutricional de pacientes acometidos de AVC atendidos em um hospital universitário no nordeste brasileiro. Rev Ensino Cienc Inov Saude. 2022;3(2):18–25.
26. Cai Z, He W, Zhuang FJ, Chen Y. The role of high high-sensitivity C-reactive protein levels at admission on poor prognosis after acute ischemic stroke. Int J Neurosci. 2019;129(5):423–9.
27. Kashani K, Rosner MH, Ostermann M. Creatinine: from physiology to clinical application. Eur J Intern Med. 2020;72:9-14.
28. Carelli GZ, Carvalho BRB, Molin BD, Duarte CR, Martins GKF, Wendt GW, et al. Alterações laboratoriais em pacientes com COVID-19. Res Soc Dev. 2020;9(12):e30191211115.
29. Teixeira SL, Ribas JLC. A importância dos exames laboratoriais no auxílio do tratamento de distúrbios estéticos. Caderno Saúde Desenvolvimento. 2021;10(18):38–51.
30. Bezerra GKA, Cabral PC. Nutrição enteral precoce em pacientes críticos e sua associação com variáveis demográficas, antropométricas e clínicas. BRASPEN J. 2018;33(4):446–50.
31. Maia LA, Olinto EOS, Feitosa GAM, Araújo RG, Anjos KDG, Lima EM, et al. Nutrição enteral precoce e desfechos clínicos em pacientes críticos. Braz J Hea Rev. 2020;3(6):19962–72.
32. Parikh HG, Miller A, Chapman M, Moran JL, Peake SL. Calorie delivery and clinical outcomes in the critically ill: a systematic review and meta-analysis. Crit Care Resusc. 2016;18(1):17–24.
33. Moraes W, Pinto JM, Skowronski CURC. Inadequação proteico-calórica da terapia nutricional enteral em ambiente hospitalar: revisão integrativa. JNT Facit Business Tecnology J. 2022;35(1):514–28.
34. Sociedade Brasileira de Nutrição Parenteral e Enteral, Sociedade Brasileira de Clínica Médica, Associação Brasileira de Nutrologia. Recomendações nutricionais para adultos em terapia nutricional enteral e parenteral. São Paulo; Associação Médica Brasileira; 2011 [citado 16 de agosto de 2023]. Disponível em: https://amb.org.br/files/_BibliotecaAntiga/recomendacoes_nutricionais_de_adultos_em_terapia_nutricional_enteral_e_parenteral.pdf.

Study location: Hospital de Caridade São Vicente de Paulo, Guarapuava, PR, Brazil.

Conflict of interest: The authors declare that there are none.