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RECOMMENDATIONS FOR SPECIALIZED NUTRITIONAL-METABOLIC MANAGEMENT OF THE CRITICAL PATIENT

Recommendations for specialized nutritional-metabolic management of the critical patient: Consequences of malnutrition in the critically ill and assessment of nutritional status. Metabolism and Nutrition Working Group of the Spanish Society of Intensive and Critical Care Medicine and Coronary Units (SEMICYUC)☆

Recomendaciones para el tratamiento nutrometabólico especializado del paciente crítico: consecuencias de la desnutrición en el paciente crítico y valoración del estado nutricional. Grupo de Trabajo de Metabolismo y Nutrición de la Sociedad Española de Medicina Intensiva, Crítica y Unidades Coronarias (SEMICYUC)

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Introduction

Nutritional status is a crucial factor, since it conditions critical patient outcome. Malnutrition in such individuals is considered to be an independent indicator of a poor prognosis, being associated to increased mortality, a longer stay in the Intensive Care Unit (ICU), a higher incidence of infections, fewer days without mechanical ventilation (MV) and increased costs.

Acute malnutrition in the critical patient is intimately related to inflammatory status, and this relationship must be considered when assessing the situation of the patient. In this context we need tools that take these concepts into account. Only two scales have been found to be useful for assessing nutritional status in the hospital setting: the Nutritional Risk Screening (NRS) 2002[1] and the Nutrition Risk In the Critically ill (NUTRIC Score).[2] The NRS 2002 has been validated for hospitalized patients in general, but not for critical patients.[3]

Critical illness is associated to an early and aggressive acute myopathic process manifesting as a loss of muscle mass and/or ''acquired weakness of the critical patient'', and its diagnosis, prevention and treatment are very important. Ultrasound (US) is of interest in this regard, though it seems necessary to protocolize the technique in order to be able to identify and predict the loss of muscle mass, as well as to use it in monitoring patient response to therapy. Other imaging techniques such as magnetic resonance imaging (MRI) and computed tomography (CT) may also prove useful, though they are less applicable in the ICU setting.[4] Lastly, due knowledge and prevention of refeeding syndrome is also important.

Does nutritional status of the critical patient condition the clinical outcome?

The prevalence of malnutrition in critical patients admitted to the ICU ranges between 30% and 55%, depending on the criteria used for selection of the patients and the diagnosis of malnutrition.[5,6] Given the variability found in the literature, it is important to have scales capable of adequately assessing the nutritional status of the critical patient.

The critical patient is characterized by an inflammatory state linked to the severity of the background disorder, and which results in increased caloric-protein consumption, associated to greater intolerance of nutritional therapy and thus to malnutrition.[7] In turn, malnutrition is associated to increased morbidity and greater inflammation, thus completing a vicious circle that can lead to multiorgan dysfunction. An adequate nutritional intervention strategy, including correct timing of the start of feeding, administration route and nutritional solution used, could disrupt this vicious circle.

Should nutritional screening be performed upon admission to the ICU? Are the nutritional prognostic scores and indexes useful?

Nutritional screening in the ICU would not be necessary, since by definition all critical patients are at nutritional risk. However, not all patients have the same risk, and adequate individual risk assessment is therefore needed. The assessment of nutritional status is the first step in the nutritional therapeutic process. Its main objective is to identify malnourished individuals or patients at risk of developing malnutrition upon admission to the ICU and which may benefit from such therapy. Correct nutritional assessment requires a thorough case history including previous intake, days of fasting or prolonged fluid therapy before admission, and the severity of the current disease process leading to admission to the ICU.

An ideal nutritional scale should yield normal results in well-nourished individuals and altered scores in the presence of malnutrition. Likewise, it must not be influenced by non-nutritional factors, and should indicate a positive trend when nutritional therapy is adequate. Many nutritional scales have been proposed. In this regard, the Mini-Nutritional Assesment[8] was specifically designed for use in the geriatric population. The Subjective Global Assessment[9] in turn was designed for patients undergoing digestive tract surgery. Other scales are the Malnutrition Universal Screening Tool,[10] developed for use in the general population, and the NRS 2002,[11] designed for hospitalized patients. A scoring method created to specifically quantify nutritional risk in the critical patient is the NUTRIC Score[1] (Table 1). This is a multiparameter questionnaire that is easy to use, produces reproducible results and is characterized by scant interobserver variation. The NUTRIC Score is based on the premise that starvation and the inflammatory condition upon admission of patients to the ICU can influence nutritional status and outcome (mortality after 28 days), thereby contributing to identify those critical patients that are most likely to benefit from more individualized energy-protein therapy.[2] The instrument takes the following variables into account: age, APACHE II score, SOFA score, comorbidity (Charlson Comorbidity Index), the duration of hospital stay until admission to the ICU, and interleukin 6. A score of ≥ 5, even without the inclusion of interleukin 6 (simplified score), is indicative of high nutritional risk, and such patients would benefit from early artificial nutrition to reduce morbidity-mortality.

This score has been validated by different multicenter studies, including those published by Rahman et al.[12] (1199 patients) and Mendes et al.[13] (1143 patients). Both studies identified critical patients with a greater probability of deriving benefit from optimum amounts of macronutrients when taking mortality as the endpoint.

In these patients monitoring of the development of refeeding syndrome is required, with gradual reaching of the estimated or measured caloric-protein supply within 48--72 h.

How should nutritional status of the critical patient be evaluated? Are the scales and anthropometric and biochemical variables useful?

Critical patients may either present malnutrition upon admission or develop it in the ICU as a consequence of the acute disorder leading to admission to the Unit.

Table 1 Nutrition risk in the critically ill (NUTRIC score).

Parameters	Score			
	0	1	2	3
Age (years)	<50	50–74	>75	
APACHE-II	<15	15–19	20–27	≥28
SOFA	<6	6–9	≥10	
Number of comorbidities	0–1	≥2		
Days from hospital admission to ICU admission	0	≥1		
IL-6 (μg/ml)[a]	0–399	≥400		

APACHE II: Acute Physiology And Chronic Health Evaluation-II; IL: interleukin; SOFA: Sequential Organ Failure Assessment score; ICU: Intensive Care Unit.

[a] Validated for all 6 parameters and for 5 parameters if IL-6 is not available.

An adequate nutritional approach requires tools to identify the risk of malnutrition upon admission, as well as assessment scales to evaluate malnutrition in the course of patient stay in the ICU.

In recent years, a series of variables have been studied with the purpose of detecting patients at risk of malnutrition.[14] Subjective, anthropometric and biochemical variables, as well as scales, are available. However, most of these tools, when considered on an isolated basis, are of scant usefulness for nutritional assessment of the critical patient.

Subjective variables are limited by the characteristics of the development of acute malnutrition and are of little interest in the critical patient, because they refer to events occurring before admission to the ICU.

Anthropometric variables, including body mass index (BMI), evaluate and detect pre-existing malnutrition at the time of admission to the ICU. However, they are susceptible to interference by changes in the water distribution of the critical patient, and therefore are not useful for follow-up.

Biochemical variables[15] are affected by metabolic changes that modify processes of synthesis and degradation of these biochemical magnitudes in the critical patient. Nevertheless, such variables are useful in initial assessment and monitoring of the patient during admission to the ICU. Prealbumin and retinol binding protein have a short half-life (2 days and 12 h, respectively), and are very sensitive to acute changes[16]; they afford information about new events referred to metabolic stress and the anabolic phase, and are therefore useful for purposes of follow-up. Albumin and transferrin both have a longer half-life (20 and 10 days, respectively), are scantly sensitive to acute changes, and are therefore useful for initial assessment, but not for follow-up. Albumin moreover has prognostic utility for reasons different from purely nutritional considerations in critical patients.[17] Somatomedin in turn affords information about the metabolic response to aggression, is useful for follow-up, but is difficult to determine and the assay technique is moreover expensive. The determination of urinary 3-methylhistidine derived from protein metabolism provides information on muscle catabolism and refeeding, and is useful for follow-up of the critical patient.[18] Nitrogen balance expresses the catabolic state and metabolic response to stress. It is useful for evaluating the metabolic response to nutrition. Lastly, the creatinine-height index assesses the degree of muscle catabolism upon admission to the ICU, but is not useful for follow-up.

It is concluded that the biochemical parameters considered separately, although referred to proteins with a short half-life, are not useful for defining nutritional status, except perhaps in evaluating the trend of nutritional status in the course of patient stay in the ICU. In addition, currently only two scales already mentioned above – the NUTRIC Score and the NRS 2002 – may be of relevance in the critical patient.

Can other estimations be used to assess nutritional status of the critical patient?

The term ''acquired weakness of the critical patient'' is defined as weakness developing in the absence of any identifiable cause other than nonspecific inflammation, and which causes damage to the microcirculation of the peripheral nerves and muscles.[19] It is necessary not only to identify high-risk patients but also to quantify the loss of muscle mass based on objective measures that detect muscle loss, i.e., muscle loss ''biomarkers''. A number of imaging techniques are available for this purpose: magnetic resonance imaging (MRI), computed tomography (CT) and ultrasound (US).

Magnetic resonance imaging offers excellent resolution and is regarded as the gold standard[4,20] for determining body tissue composition, though in the critical patient the technique has limitations due to its high cost, the problem of moving these patients to the MRI room, difficult or impossible application in very obese individuals, and the need for experts to interpret the data.

Computed tomography is also valid in relation to quantitative and qualitative measurements, particularly in reference to adipose tissue and skeletal muscle. It allows us to identify patients with diminished muscle mass, calculating the muscle cross-sectional area,[4,21] and can be used to establish retrospective comparisons against other CT studies performed for other reasons.[4] However, the technique involves high radiation doses, is expensive, and requires moving the patient outside the ICU. Furthermore, it likewise cannot be used in very obese individuals.

Ultrasound is practically risk-free, reliable, rapid and can be performed at the patient bedside. Furthermore, it is inexpensive and reproducible, and is reliable in measuring subcutaneous and visceral adipose tissue, as well as in measuring skeletal muscle mass – allowing us to identify individuals with a low muscle levels.[22,23] The inconveniences of US are the lack of standardization of the measurement techniques, and the fact that its results are affected by errors in use of the technique, due to the lack of protocols and the presence of anatomical variants. On the other hand, US offers data that are more qualitative than quantitative, with difficulty in interpreting and discerning images, since the technique is highly operator-dependent.[4] Nevertheless, US is of maximum interest in patients of this kind, and consensus is needed to identify and predict the loss of muscle mass, identify patients at risk of malnutrition, and monitor the response to nutritional support and physiotherapy and/or rehabilitation. Lastly, it is often necessary to rule out other acute generalized weakness syndromes that are sometimes associated to malnutrition, based on electromyographic studies, nerve conduction tests or even muscle biopsies.[24]

How do we define and prevent refeeding syndrome in the critical patient?

Refeeding syndrome is characterized by a potentially fatal series of symptoms that may develop secondary to compartmental fluid and electrolyte changes in malnourished patients fed via the enteral or parenteral route. The main biochemical feature of the disorder is hypophosphatemia, though it can manifest together with anomalous fluid and sodium balances, thiamine deficiency, hypopotassemia, hypomagnesemia and changes in the metabolism of glucose, proteins and lipids. The critical patients at greatest risk of developing refeeding syndrome are those with malnutrition or who have received a low energy supply during prolonged periods of time.[14] Its prevention requires the start of refeeding with a low energy supply and simultaneous correction of the water-electrolyte imbalances, and vitamin supplementing.[25,26]

In order to avoid underdiagnosed disease[27] it is advisable to initially administer 10–15 kcal/kg/day, and from day 4, the dose can be incremented to 15–20 kcal/kg/day, progressing to 20–30 kcal/kg/day from day 7, until the patient requirements are covered.[28] The plasma phosphorus, magnesium and potassium levels must be monitored, with the optimization of fluid therapy and sodium supply. The administration of 200–300 mg of thiamine via the intravenous route at least 30 min before the start of refeeding is advised, followed by 200–300 mg/day during the first 3 days.

Recommendations

- The use of isolated anthropometric or biochemical variables is recommended for initial nutritional assessment, but not for nutritional follow-up of the critically ill. (Level of evidence: moderate. Grade of recommendation: moderate).
- Follow-up of the evolution of shorter half-life proteins such as prealbumin or retinol binding protein, and the determination of urinary 3-methylhistidine, may be useful for the nutritional follow-up of critical patients. (Level of evidence: low. Grade of recommendation: low).
- The NUTRIC Score upon admission should be used to assess the patient prognosis, but not as a nutritional assessment tool. (Level of evidence: moderate. Grade of recommendation: moderate).
- It is advisable to evaluate the patient muscle compartment over the course of ICU stay using imaging techniques such as MRI and CT. Ultrasound may afford valid data at a lesser cost and with greater observer and patient comfort. (Level of evidence: moderate. Grade of recommendation: moderate).
- Identification and prevention of refeeding syndrome is required in malnourished critical patients or individuals receiving a low energy supply for prolonged periods of time, or with risk factors for the development of malnourishment. (Level of evidence: low. Grade of recommendation: high).

Conflicts of interest

Dr. J.F. Martínez-Carmona declares training activities with Fresenius-Kabi. The rest of the authors declare that they have no conflicts of interest.

Note to supplement

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