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Consensus SEMICYUC-SENPE: Nutritional assessment
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Chapter 3
Guidelines for specialized nutritional and metabolic support in the critically-ill patient. Update. Consensus SEMICYUC-SENPE: Nutritional assessment

S. Ruiz-Santana, J. A. Arboleda Sánchez and J. Abilés


Abstract

Current parameters to assess nutritional status in critically-ill patients are useful to evaluate nutritional status prior to admission to the intensive care unit. However, these parameters are of little utility once the patient’s nutritional status has been altered by the acute process and its treatment. Changes in water distribution affect anthropometric variables and biochemical biomarkers, which in turn are affected by synthesis and degradation processes. Increased plasma levels of prealbumin and retinol —proteins with a short half-life— can indicate adequate response to nutritional support, while reduced levels of these proteins indicate further metabolic stress. The parameters used in functional assessment, such as those employed to assess muscular or immune function, are often altered by drugs or the presence of infection or polyneuropathy. However, some parameters can be used to monitor metabolic response and refeeding or can aid prognostic evaluation.

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Key words: Nutritional status. Biochemical variables. Energy balance.

Introduction

In the physiopathology of malnutrition related to critical illness, a significant role is played by the different levels of acute or chronic inflammation, leading to an altered body composition and a loss of functions including cognitive, immune and muscle function (IV). Increased catabolism may in more severe cases contribute to mortality or, conversely, be self-limited if the critical disease itself is resolved (IV).

The assessment of nutritional status in critically-ill patients aims:

– To assess nutritional status at the time of admission to the intensive care unit (ICU).
– To identify the group of patients most likely to benefit from receiving nutritional support.

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SEMICYUC: Spanish Society of Intensive Care Medicine and Coronary Units.
SENPE: Spanish Society of Parenteral and Enteral Nutrition.

– To identify individually the causes and consequences in terms of morbidity and mortality of malnutrition.
– To identify the limits of the different available techniques of nutritional assessment and their applicability to critically-ill patients.

What value do anthropometric variables and structured questionnaires have in the nutritional assessment of the critically ill?

**Weight**

It measures in a simplified way total body components. Its diagnostic capacity as an indicator of nutritional status may be improved if it is used to construct indicators such as percent weight loss and body mass index (BMI). An involuntary weight loss greater than 10% within the last 6 months or current weight below 90% of the ideal weight are classical signs of malnutrition. It is an adequate indicator in surgery and chronic diseases and of malnutrition on admission.

**Body mass index**

It evaluates the correlation between weight and height. Indices < 18.5 kg/m² are indicative of malnutrition and are associated with a significant increase in mortality in surgical patients. In contrast, indices > 30-35 kg/m² suggest overweight-obesity and allow to assess overnutrition. It has recently been observed that critically-ill patients with higher BMI values showed a greater risk of developing acute respiratory distress syndrome and a longer hospital stay than patients with normal weight³ (IIb).

**Other anthropometric variables**

The most commonly used are the triceps skin fold and arm circumference (AC). While the former is the most widely used method to estimate subcutaneous body fat and AC has been postulated as an indicator of the state of preservation of the muscle compartment, both methods are of little value in the nutritional assessment of the critically ill.

**Subjective global assessment**

It is the structured questionnaire that has been validated in a large part of the population, based on clinical interpretation and on some symptoms and physical parameters. The subjective global assessment (SGA) of nutritional status, performed by experts, is a good indicator of malnutrition and may predict the course of ICU patients⁴ (III), though this appears to be questioned in elderly patients⁵ (III). Evaluated by experts, it is the most reliable malnutrition parameter on admission.

What biochemical variables are recommended for assessing the nutritional status of the critically ill?

As with anthropometric parameters, biochemical variables are affected by the response of the body in the acute phase and are influenced by nonnutritional disorders in critically-ill patients, so their interest in interpreting nutritional status is limited.

**Biochemical variables indicative of muscle protein status⁶ ⁷ (III)**

– Creatinine/height index. This measures muscle catabolism. Its values are influenced by the amount and protein content of the diet and age. It is not a useful parameter in renal failure. In critically-ill patients, this index detects malnutrition on admission, but has no prognostic or follow-up value alone.
– 3 methylhistidine (3-MH). It is an amino acid derived from muscle protein metabolism. Its values increase in situations of hypercatabolism and decrease in the elderly and malnourished patients. In critically-ill patients, it is a parameter for monitoring nutrition, renutrition, and muscle catabolism.
– Urea excretion. This is a standard method for measuring protein catabolism. It also estimates creatinine and uric acid loss. Its values vary in relation to intravascular volume, nitrogen intake and renal function. In the critically-ill patient, it is an index of the intensity of the metabolic response to stress.
– Nitrogen balance. It is a good renutrition parameter in postoperative patients with stress or moderate malnutrition. It may be useful to establish if a patient is catabolic, in equilibrium, or anabolic. In critically-ill patients, it is not valid as a parameter for malnutrition and nutritional monitoring, but as an index of nutritional prognosis. To monitor nitrogen intake, urea may also be used.

**Biochemical variables indicative of visceral protein status⁶ ⁷ (III)**

– Albumin. It is the biochemical parameter most commonly used for nutritional assessment. A significant reduction in albumin concentrations is associated with an increased rate of complications and mortality. Its plasma concentration is highly influenced by changes in water content. Albumin values on admission are prognostic. However, these values are poorly sensitive to acute changes in nutritional status due to the long half-life of albumin of about 20 days.
– Prealbumin or transthyretin. Its half-life, 2 days, makes it a parameter for monitoring the course of criti-
Muscle function parameters are useful in nutritional assessment of the critically-ill patient?

Muscle function parameters (III)

Analysis of muscle strength, both actively (strength of respiratory muscles, grasping capacity) and passively (contraction and muscle relaxation response to different electrical intensities), was used as an indicator of nutritional status. Its values were more sensitive and specific in predicting surgical complications, than biochemical markers such as albumin or transferrin. However, in critically-ill patients muscle function tests may be altered by highly diverse factors such as the use of sedation analgesia, muscle relaxants or the presence of myopathy and/or polyneuropathy.

Immune function parameters

The reduced total lymphocyte count (< 1,500), CD3/CD4 ratio (< 50) and absence of the delayed cell mediated immune response have been associated with malnutrition. In critically-ill patients, both lymphocyte counts and immune function tests may be altered by a large number of clinical situations or by medication. These parameters may be of value in monitoring the course of critically-ill patients showing a deficiency in immunity on admission.

The activity of mitochondrial complex I in peripheral blood mononuclear cells decreases with malnutrition and rapidly increases after refeeding, and thus may be a good marker of the nutritional status (III).

There is no evidence of its usefulness in critically-ill patients or in the study of possible confounding factors in such patients. Measurement of the apoptosis rate of oral epithelium may be another noninvasive technique to determine nutritional status, though this technique requires further studies for it to be validated (III).

Are nutritional prognostic indices of value in critically-ill patients? (III)

These indices have been designed for predicting surgery risk, the development of postoperative complications and the indication to start nutritional support on patient admission, based on assessment of nutritional status. They are not adapted to critically-ill patients and are of little value in them.

Are there other less common parameters useful for nutritional assessment in critically-ill patients?

The difficulty in assessing the presence of malnutrition in critically-ill patients leads to the need to search for other methods for its detection. Neutron activation analysis, which measures total body nitrogen, bioelectric impedance, which allows calculation of total body water volume, and potassium isotopes, which are used to estimate total lean tissue mass, are techniques of limited clinical value in critically-ill patients at present. Energy balance (defined as the difference between the prescribed calories and dietary administered calories) and the adaptation of diet are valid tools, since a low-calorie diet and persistently
negative energy balances are associated with adverse clinical outcomes14 (IIb).

Serum leptin concentrations may be a good predictor of nutritional status, as has been shown in studies done in the elderly, but there is still not sufficient evidence for their value in critically-ill patients15,16,17.

**Recommendations**

- The anthropometric parameters or biochemical markers most commonly used to evaluate nutritional status should not be recommended in clinical practice in critically-ill patients (C).

- To assess nutritional status on admission, weight loss, BMI or SGA may be used. To monitor renutrition, nitrogen balance, prealbumin, retinol and 3-MH may be used. To assess metabolic response, urea excretion, nitrogen balance and 3-MH may be useful. As prognostic parameters, nitrogen balance and albumin may be used (C).

As a guide, the assessment and follow-up parameters proposed in Table I may be used.

**Conflicts of interest**

The authors state that they have participated in activities financed by the pharmaceutical industry for marketing of nutritional products (clinical studies, educational programs and attendance at scientific events). No pharmaceutical industry has participated in the preparation, discussion, writing and establishing of evidence in any stage of these recommendations.

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**Table I**

<table>
<thead>
<tr>
<th>When to measure</th>
<th>Parameter</th>
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</thead>
<tbody>
<tr>
<td>On admission</td>
<td>Weight, height, weight loss, BMI, albumin, cholesterol</td>
</tr>
<tr>
<td>Daily</td>
<td>Energy balance, urea</td>
</tr>
<tr>
<td>Once a week</td>
<td>Adjust requirements to stress factor, nitrogen balance, creatinine/height index, prealbumin, retinol-binding protein (RBP) changes</td>
</tr>
</tbody>
</table>

BMI: Body mass index.

**References**


