ABRAN ASSOCIAÇÃO BRASILEIRA DE NUTROLOGIA
International Journal of Nutrology
(Official Journal of the ABRAN - Brazilian Association of Nutrology)

Original Article

Nutritional Management of Critically Ill Patients Infected with SARS-CoV-2

Manejo nutricional de pacientes criticamente enfermos infectados com SARS-CoV-2

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Int J Nutrol 2021;14:2–5.

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Abstract

Early nutritional therapy is essential to ensure the maintenance of adequate energy/protein intake for critically ill patients infected with severe acute respiratory syndrome caused by COVID-19 (SARS-CoV-2) infection. However, this poses a major challenge when it comes to individuals on mechanical ventilation in prone position. Therefore, the present work presents a nutritional therapy flowchart developed for patients with SARS-CoV-2 infection to guide nutritional management and ensure that energy/protein intake goals are met, thus favoring a positive clinical outcome.

Keywords
- coronavirus
- nutritional therapy
- SARS

Resumo

A terapia nutricional precoce é essencial para garantir a manutenção da ingestão adequada de energia / proteína para pacientes criticamente enfermos infectados com síndrome respiratória aguda grave causada pela infecção por COVID-19 (SARS-CoV-2). No entanto, isso representa um grande desafio quando se trata de indivíduos em ventilação mecânica na posição prona. Portanto, o presente trabalho apresenta um fluxograma de terapia nutricional desenvolvido para pacientes com infecção por SARS-CoV-2 para orientar o manejo nutricional e garantir que as metas de ingestão de energia / proteína sejam atingidas, favorecendo assim um desfecho clínico positivo.

Palavras-chave
- coronavírus
- terapia nutricional
- SARS

Introduction

Careful attention should be paid to nutritional care in patients admitted to intensive care units (IUCs) with confirmed or suspected severe acute respiratory syndrome caused by COVID-19 (SARS-CoV-2) infection. As the coronavirus disease (COVID-19) develops, patients experience rapidly worsening oxygenation, inducing protein catabolism. The main consequence is protein depletion, especially muscle proteins, contributing to progressive weakness, worsening respiratory status, and overall rehabilitation, and leading to increased difficulty in efficiently sustaining extubation[1].

Depending on the course of the disease, patients may develop hyperinflammation,[1,2] in which the physiological response is associated with increased oxygen consumption and energy expenditure, resulting in cellular catabolism. Stress response activation involves the regulation of the

received October 22, 2020
accepted December 21, 2020

DOI https://doi.org/10.1055/s-0041-1726058.
ISSN 1984-3011.

sympathetic nervous system and the release of hormones, such as cortisol, glucagon, endogenous catecholamines, and proinflammatory cytokines, leading to hyperinflammation. Catecholamines are responsible for lipolysis, resulting in the release of fatty acids into the circulation. Blood glucose levels increase due to the stimulation of glycolysis by glucagon and gluconeogenesis. Gluconeogenesis is aided by cortisol, which promotes muscle proteolysis and occurs throughout all stages of the stress and trauma process.

This metabolic/hormonal response leads to hyperglycemia, caused by peripheral insulin resistance and increased hepatic gluconeogenesis due to accelerated proteolysis. Aminoacids released at this stage play an important role in tissue repair, immune defense, and acute-phase protein synthesis. Acute metabolic stress is, therefore, a sign of a hypermetabolic/hypercatabolic state.[3] In the short term, this is probably an adaptive response, but with time and persistent inflammation, it becomes a risk factor for caloric/protein malnutrition, immunosuppression, and alterations in functional muscle tissue due to protein catabolism. Early nutrition therapy can minimize or reverse the catabolic state in the long term, favoring a positive clinical outcome.[4]

Nutritional status may be affected by prolonged length of stay in ICUs due to clinical deterioration, whereby immobility due to neuropathy and/or the administration of muscle blocking agents leads to lean mass loss; reduced energy/protein supply due to prolonged periods of fasting before adopting nutritional therapy for patients who are unable to be fed orally or due to the need to maintain fasting due to clinical instability (hemodynamic instability, respiratory instability, or severe acidosis); fasting for tests and diagnostic and therapeutic procedures; and enteral feeding tolerance issues, resulting in abdominal distension, reflux and vomiting; and an inadequate understanding of the importance of nutritional therapy in severe cases.[5]

The nutritional management of serious cases of COVID-19 is, in principle, similar to that of other ICU patients with respiratory impairment. Given the lack of direct evidence from COVID-19 patients, especially those who develop septic shock, many of the following recommendations are based on indirect evidence from critically ill patients in general and from patients with sepsis and acute respiratory distress syndrome (ARDS).[3,6]

Nutritional Risk and Goals Calculation

Patients with confirmed or suspected SARS-CoV-2 infection requiring intensive care should be considered at nutritional risk, and a nutritional care plan is necessary. However, normally used nutritional risk screening tools should not be used in these cases to minimize the risk of contact and infection of the multidisciplinary team. The weight of the patient on admission to the hospital is of fundamental importance and should be measured, if possible. In cases of clinical impossibility or lack of appropriate equipment, or to minimize the risk of contagion, the weight may be informed by the patient or family members. If the ICU has bed scales for patients with COVID-19, the actual weight may be used, as long as there are no signs of significant edema or anasarca. In the case of lack of information about the weight of the patient, the ideal weight for height according to gender and age may be used, or, as a fallback option, the ideal weight for a fixed body mass index (BMI) of $23kg/m^2$, provided that the height of the patient is known.[3,7]

For the estimation of energy/protein requirements, the current severity of clinical status should be considered, including: hemodynamic status (average arterial pressure, use of vasoactive drugs), blood pH, and respiratory status (O2 saturation, respiratory rate and, in intubated patients, PaO2/FiO2 ratio). Based on these parameters and on the response to early metabolic decompensation induced by COVID-19, energy demands in the 1st 3 days of intensive care are lower, respecting the need to provide a lower supply for patient safety reasons (tolerance and metabolism) and to stimulate adequate elimination of dysfunctional intracellular organelles (autophagy). Hypoxia and increased production of reactive oxygen species (ROS) can lead to mitochondria malfunction. Thus, autophagy is a necessary process to ensure a better adaptive response and overall rehabilitation. In view of was explained above, in the 1st 3 days, supplying between 40 and 70% of the nutritional goals is acceptable and allowed.[7] Between the 4th and 11th days, needs should be adjusted due to a peak in the catabolic process, with loss of lean mass induced by systemic inflammation and generalized muscle weakness. At this point, a minimum protein and energy supply equal to 70% of the goals should be ensured within a desired amount of between 90 and 110%, depending on the tolerance of the patient. In addition, the provision of psychological support, physiotherapy, and speech therapy for extubated patients is of fundamental importance due to a significant risk of dysphagia. After the 12th day of hospitalization, new goals must be set, taking into account the process of physiological malnutrition that occurred on the previous days. Here, the aim is to promote nutrition repletion – delivering an adequate energy/protein supply by ensuring an ideal intake of between 90 and 110% of the nutritional goals – and overall rehabilitation, providing physiotherapy and speech therapy up to discharge.[3,7]

Protein goals should also follow the same parameters mentioned above, according to the severity and stage of the disease. Smaller protein goals are suggested initially. After the 4th day, protein requirements increase significantly – in general, requirements increase by between 30 and 50% depending on catabolism – and supply should be monitored.[3] These higher protein demands should dictate the hyperproteic enteral and parenteral formulas and oral supplements used, which should consist of $\geq$ 20% proteins and are thus considered to be hyperproteic (►**Table 1**).

The flowchart in ►**Fig. 1** shows the nutritional therapy to be adopted according to the severity of the COVID-19 symptoms.

Table 1 Caloric/protein goals

Patient	1st–3rd day	4th–11th day	12th day and after
Obesity Grade III	11 Kcal/kg/day – 0.8 g/kg (actual weight)	13 Kcal/kg/day – 0.9 g/kg (actual weight)	15 Kcal/kg/day – 1.0 g/kg (actual weight)
Obesity Grade I-II	15 Kcal/kg/day – 1.0 g/kg (actual weight)	18 Kcal/kg/day – 1.1 g/kg (actual weight)	22 Kcal/kg/day – 1.2 g/kg (actual weight)
Very Elderly	18 Kcal/kg/day – 1.0 g/kg	22 Kcal/kg/day – 1.2 g/kg (+30%)	32 Kcal/kg/day – 1.5 g/kg
Elderly	20 Kcal/kg/day – 1.0 g/kg	25 Kcal/kg/day – 1.2 g/kg (+30%)	35 Kcal/kg/day – 1.5 g/kg
Young Adult	20 Kcal/kg/day – 0.8 g/kg	25 Kcal/kg/day – 1.5 g/kg	35 Kcal/kg/day – 1.5 g/kg

Garnes S.A. et al.(adapted); Nutrition, 2018.[3] Note: For obese patients, use actual weight for energy/protein calculations.

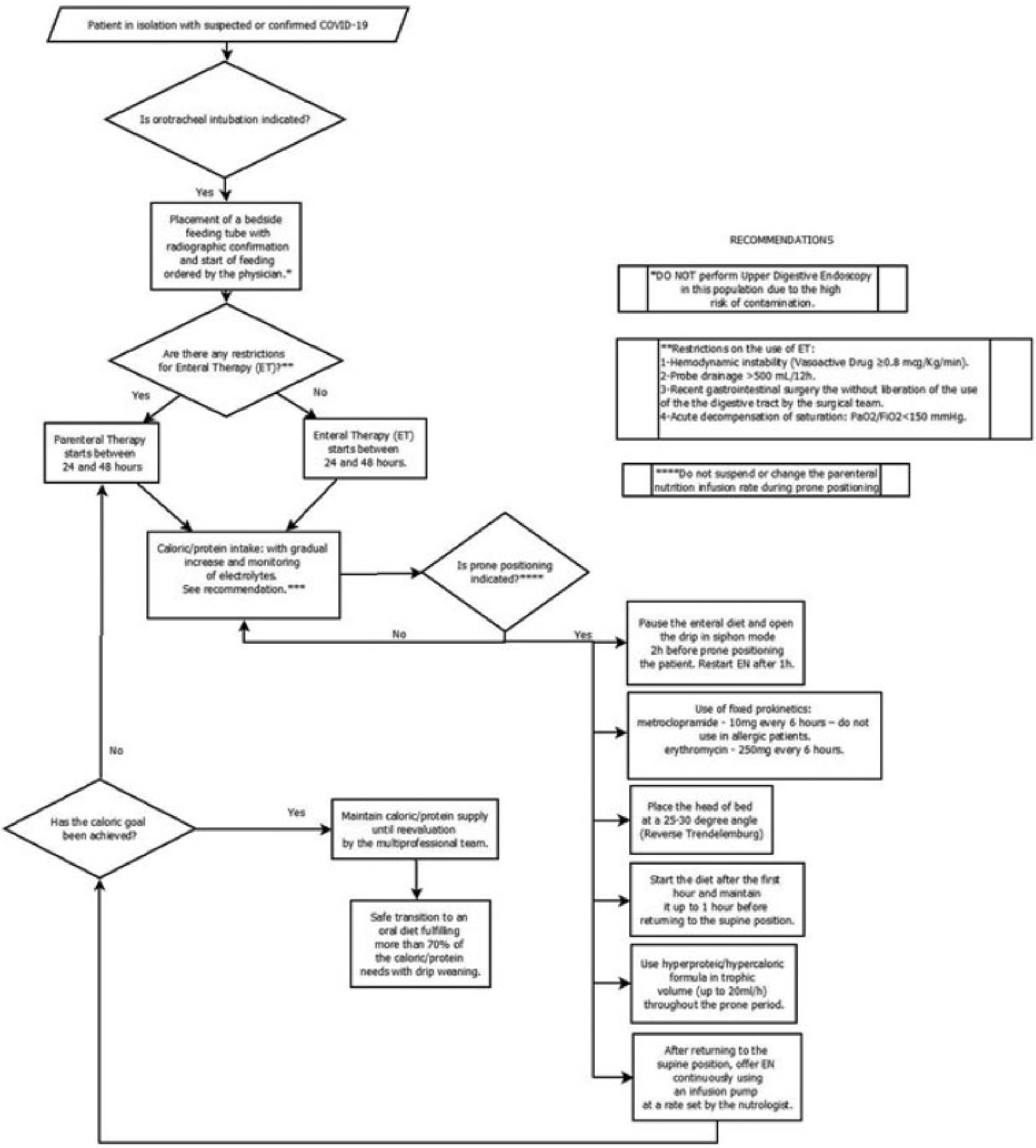

Fig. 1 Nutritional therapy flowchart for patients with Severe Acute Respiratory Syndrome caused by SARS-CoV-2 infection. The flowchart represents a proposal for nutritional therapy for critically ill patients with SARS-CoV-2 infection.

Conclusion

In conclusion, patients infected with SARSCoV-2 may develop a hypercatabolic and hyperinflammatory state, leading to extreme lean mass loss. Patients requiring mechanical ventilation may not achieve the caloric/protein goals, thus negatively affecting the clinical outcome. The flowchart presented here aims to ensure the provision of adequate energy/protein intake for critically ill COVID-19 patients, thus facilitating disease management by health professionals and favoring positive clinical outcomes.

Author Contributions

- Garnes S. A. was responsible for designing and drafted the flowchart used in the nutritional therapy of critically ill patients.
- Lasakosvitsch F. was responsible for performing the literature review and drafted the flowchart.
- Bottoni A. was responsible for carrying out the critical review of the article.
- Bottoni A. was responsible for the approval of the final version.

Conflict of Interests

The authors have no conflict of interests to declare.

Acknowledgments

The present article was translated by Vanina Monique TUCCI-VIEGAS, Ph.D., Biologist & Translator/Reviewer of Scientific, Medical, and Technical Texts. E-mail address: vanina.monique@gmail.com.

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