Medical Nutrition Therapy (COVID-19)

Expert recommendations for nutritional therapy for critically ill patients with new coronavirus pneumonia

Abstract : The current fight against the new coronavirus epidemic has entered a decisive battle phase. Nutrition treatment for critically ill patients is a key measure to reduce mortality. In order to further improve the effectiveness of nutritional treatment for critically ill patients, combined with clinical experience in the frontline of anti-epidemic disease, nutritional metabolism characteristics, nutritional screening, nutritional treatment target amount, choice of nutritional programs and pathways, and nutritional monitoring methods, etc. The conclusions and suggestions were made to provide reference for the treatment of critically ill patients.

Keywords : new type of coronavirus pneumonia; nutritional therapy for critically ill patients ; enteral nutrition; parenteral nutrition

Recommendations for nutrition therapy in critically ill COVID-19 patients

Abstract : At present, fighting against the novel coronavirus pneumonia (COVID-19) epidemic is entering the decisive stage, and nutritional treatment of critically ill patients is a key measure to reduce the mortality. This paper aims to provide recommendations to improve the effect of nutrition therapy among the critically ill COVID-19 patients. Taken the front-line clinical experience and metabolic characteristics of critically ill patients into consideration, we have made recommendations on characteristics of nutritional metabolism, nutrition screening, nutritional requirements, choice of nutrition programs and approaches , and monitoring method of nutrition during the treatment for critically ill COVID-19 patients.

Key words : COVID-19 critically ill patients nutrition therapy enteral nutrition parenteral nutrition

The critically ill patients with new type of coronavirus pneumonia (hereinafter referred to as "neochronic critically ill patients") refer to patients diagnosed with any of the following: respiratory failure and mechanical ventilation required; shock; combined with other organ failures need to be admitted to the intensive care unit (ICU) treatment.

The new crown critically ill patients often significant systemic inflammation of the body in a high catabolic state [.1-.3] . Due to the release of various stress-related hormones and pro-inflammatory cytokines and insufficient oxygen supply, its nutritional metabolism is mainly characterized by: (1) reduced glucose oxidative energy supply, increased glycolysis, enhanced gluconeogenesis, and insulin resistance , Increased blood sugar; (2) increased protein breakdown, increased protein synthesis in the acute phase, decreased muscle protein synthesis, and changes in amino acid spectrum: such as decreased branch chain amino acid (BCAA) concentrations; (3) increased fat mobilization and decomposition; (4) multiple Increased consumption of vitamins and trace elements. In this case, patients are prone to malnutrition, and the incidence of malnutrition is higher in patients with chronic underlying diseases.

The main causes of malnutrition are imbalances in energy supply and demand for the body, including: (1) increased energy consumption. Due to factors such as fever, increased work of breathing muscles, and mechanical ventilation, the energy consumption of the body increases, and the demand for energy also increases. (2) Metabolic disorders. Impaired glucose utilization, increased protein and fat breakdown, and a negative nitrogen balance in the body. (3) Insufficient intake and malabsorption of nutrients. Insufficient appetite, dyspnea, mechanical ventilation, and disturbance of

consciousness after long-term bedridden can lead to inadequate intake of patients. Neocoronavirus can directly attack the gastrointestinal tract, diarrhea, nausea, vomiting caused by drug treatment or enteral nutrition intolerance Gastrointestinal symptoms or dysfunction can lead to malabsorption and increased loss of nutrition [4] .

If malnutrition occurs in critically ill patients in the new crown, it will not only reduce respiratory muscle function and respiratory muscle weakness, but also aggravate immune dysfunction and further worsen the disease. Therefore, carrying out reasonable nutrition assessment and support to prevent malnutrition is one of the important treatment measures for critically ill patients with new crowns.

1 Nutrition Screening for Critical Patients in the New Crown1.1 Screening Tools

For critically ill patients with new crowns, dynamic nutritional risk screening is recommended. NRS 2002 can be used for nutritional risk screening (Table 1). Combined with the actual situation of the front line of anti-epidemic, some critically ill patients' body weight and diet history may be difficult to obtain, and the application of NRS 2002 is limited. In this case, a modified NUTRIC score (Table 2) is recommended for screening.

Table 1 NRS 2002 Nutrition Risk Screening Form

NRS 2002 Nutrition Risk Screening Form	
Disease severity score	
□ General malignant tumors □ Hip fractures □ Long-term hemodialysis □ Diabetes □ Chronic diseases (such as liver cirrhosis, chronic obstructive pulmonary disease)	1 point
□ Malignant blood tumor □ Severe pneumonia □ Big abdominal surgery □ Stroke	2 minutes
□ Cranial brain injury □ Bone marrow transplantation □ Intensive care patients (APACHE Ⅱ ＞ 10)	3 points
2. Scoring of impaired nutrition	
□ The body weight has decreased by more than 5% in the last 3 months, or the food intake has decreased by 1/4 ~ 1/2 in the past 1 week.	1 point
□ The body weight has decreased by more than 5% in the last 2 months, or the food intake has decreased by 1/2 ~ 3/4 in the last 1 week, or the BMI is less than 20.5 kg / m ^{2} and the general situation is poor	2 minutes
□ The body weight has decreased by> 5% in the last month, or the food intake has decreased by more than 3/4 in the last week, or the BMI is <18.5 kg / m ^{2} and the general situation is poor	3 points
3. Age score	
□ Age ＞ 70 years old	1 point
Total score = disease severity score + nutritional impairment score + age score	

Table 2 Improved NUTRIC score table

project	range	Score
age)	<50	0
	50 ~ 74	1
	≥75	2
APACHE Ⅱ score (points)	<15	0
	15 ~ 19	1
	20 ~ 27	2
	≥28	3
SOFA score (points)	<6	0

project	range	Score
	6 ~ 9	1
	≥10	2
Number of organs causing insufficiency (number)	0 ~ 1	0
	≥2	1
Length of hospital stay before admission to the ICU (d)	0 ~ 1	0
	＞ 1	1
APACHEⅡ score: acute physiology and chronic health assessment Ⅱ score; SOFA score is sequential organ failure score; total score is the sum of all score		

1.2 Judging Criteria

NRS 2002 score ≥ 3 points, suggesting that there is nutritional risk, and nutrition intervention is needed; NRS 2002 score ≥ 5 points or modified NUTRIC score ≥ 5 points (not considering IL-6), suggesting that patients have higher nutritional risks, and it should be as early as possible Give nutritional support [1,5]. The nutritional status of critically ill patients in the new crown may change rapidly. For patients whose first screening result is low nutritional risk, it is recommended to screen again after 3 days.

2 Nutrition treatment for critically ill patients with new crown2.1 Determination of nutritional target amount2.1.1 Energy

Energy target quantity: Indirect calorimetry (metabolic vehicle) is currently recognized as an ideal method for measuring the actual energy consumption value of the human body, but the frontline medical resources for the rescue of critically ill patients with new crowns are scarce, there is often no metabolic vehicle equipped, and the method is cumbersome , Easy to cross infection, so it is not applicable. Therefore, it is recommended that the resting energy expenditure (REE) can be calculated from the VCO_2 value measured by the ventilator . The calculation formula is: REE (kcal) = VCO_2 × 8.19. If it can not be the VCO_2 was measured, the estimated energy requirement according to body weight: For non-obese critically ill patients, the recommended amount of energy target of 25 ~ 30 kcal per day / kg (body weight over the calculation) [5,.7-.9] , Ideal body weight (kg) = height (cm)-105 (suitable for adult males), ideal body weight (kg) = [height (cm)-100] × 0.85 (suitable for adult females). For obese and critically ill patients, if the BMI is 30 ~ 50 kg / m^2 , the recommended energy target is 11 ~ 14 kcal / kg per day (calculated by actual body mass). If BMI> 50 kg / m^2 , the recommended energy target is 22 ~ 25 kcal / kg per day (calculated by ideal body mass) [5] . In addition, drugs such as glucose-containing liquids (such as dextrose: 3.4 kcal / g, glycerol / glycerol: 4.3 kcal / g) and fat-containing liquids (such as propofol: 1.1 kcal / mL) are required to provide additional Take energy into account [5] .

Start feeding at a low dose and reach the energy target amount within 3 to 7 days: for patients with critically ill patients with new hemodynamic instability, nutritional support should be started as soon as possible after fluid resuscitation is completed and hemodynamics is basically stable [7] . In the initial stage of stress such as infection, feeding should be started at a low dose, and the nutritional supply should not exceed 70% of the target amount [6] . You can also try to tolerate low calories (≤50% of the target feeding amount [10] or 10 per day ~ 15 kcal / kg [11]). After stabilization, the energy intake should be gradually increased to the target amount within 3 to 7 days [8] .

2.1.2 Protein

Target amount of protein: improve the energy supply ratio of protein, from 15% to 25% ~ 30% [8] . It can also be estimated based on body weight: for non-obese patients, the recommended daily protein target amount is 1.2 ~ 2.0 g / kg (calculated with ideal body weight) [5, 8] ; for obese patients, such as BMI of 30 ~ 40 kg / m^2 , the target amount of protein is 2 g / kg (calculated with ideal body mass); if BMI ≥ 40 kg / m^2 , the target amount of protein is 2.5 g / kg (calculated with ideal body mass) [5] . Patients with impaired renal function and not receiving continuous renal replacement therapy (CRRT) should appropriately reduce protein intake; for patients undergoing CRRT, protein intake should be increased with a target amount of 1.5 to 2.0 g / kg.

Increasing the supply of high-quality protein and branched chain amino acids (BCAA): Increasing the supply of high-quality protein, such as whey protein and other animal proteins, so that its proportion reaches 50% of the total protein, it is more beneficial to prevent muscle loss and promote getting out of bed Enhance the strength of respiratory muscles and promote cough and expectoration [8] . It is recommended to supplement BCAA and increase its proportion to 35%, which can not only significantly inhibit muscle breakdown, but also improve insulin resistance and enhance the efficacy of interferon [8] .

Non-protein thermal energy / nitrogen ratio: It is recommended to reduce the non-protein thermal energy / nitrogen ratio to (100 ~ 150 kcal): 1 g [8] .

2.1.3 Fat

Target fat amount: The total fat energy supply ratio of the recommended diet and tube feeding nutrition reaches 25% ~ 30% of the total energy [12] . For patients with new crowns who are critically ill with parenteral nutrition, due to changes in fat absorption and metabolism, excessive intravenous injection of fat can lead to lipid overload and toxicity, leading to hypertriglyceridemia and abnormal liver function. Glycerol concentration levels are associated with improved survival [6] . Therefore, it is recommended that the daily venous fat is 1 g / kg, and the maximum is not more than 1.5 g / kg, and the dose needs to be adjusted according to individual tolerance [6] .

Types of fats: For newly crowned critically ill patients with an oral diet, the intake of essential fatty acids is increased through a variety of cooking vegetable oils, especially monounsaturated fatty acid vegetable oils [12] . For the new crown critically ill patients with parenteral nutrition, the use of medium and long chain fatty acids is preferred. Compared with long chain fatty acids, the oxidative utilization of fatty acids can be improved [8] , but pure soybean oil fat emulsion is not recommended. In addition, the use of omega-3 fatty acids in critically ill patients has a lower risk of infection and death, and a shorter hospital stay. Therefore, it is recommended to increase the proportion of fish oil (mainly omega-3 fatty acids) [8] . Omega-9 fatty acids have immune-neutral effects and have less interference with hemodynamics, endothelial cell function, immune function and liver function, so it is recommended to increase the proportion of olive oil (mainly omega-9 fatty acids) [8] .

2.1.4 Glycolipid ratio

Endogenous glucose production is increased in critically ill patients and insulin resistance is present. Too much glucose can lead to high blood sugar, increase CO_2 production, increase fat synthesis, and increase insulin requirements. In addition, compared with fat-based energy supply, glucose-based energy supply has no advantage in saving protein. Therefore, it is recommended to reduce the energy supply ratio of glucose, and the sugar / lipid is (50 ~ 70) / (50 ~ 30) [8] . The minimum carbohydrate requirement is 2 g / kg of glucose per day. For critically ill patients with new crowns, continuous dynamic monitoring of blood glucose levels should be performed, and the target blood glucose value should be controlled between 7.8 and 10.0 mmol / L [10] . Hyperglycemia (blood glucose level> 10 mmol / L) will increase patient mortality

and infection complications and should be avoided as much as possible [6]. If the blood glucose is consistently greater than 20 mmol / L, it is recommended to inject insulin with a micropump [10].

2.1.5 Liquid volume

Follow the general principles of fluid therapy, which is to stabilize patients at 30 to 40 mL / kg per day. The minimum amount of fluid for critically ill patients to meet the main nutrient requirements, within limits. For every 1 ° C increase in body temperature, supplement 3 ~ 5 mL / kg (calculated as 4 mL / kg) [8]. Most patients with new crown crises have pulmonary edema and fluid accumulation. While maintaining fluid balance, it is even more necessary to prevent excess fluid, especially intravenous fluid volume [8].

2.1.6 Micronutrients

The new crown critically ill patients, should a conventional multiple-micronutrient supplementation, in particular vitamin B1, vitamin C, selenium, zinc, as the reference standard normal dosage recommended nutrient intake (RNI) values [6, 8-9]. Micronutrients recommended amount of total parenteral nutrition, see Table 3 [13-14]. When patients with impaired liver and kidney function, increased gastrointestinal loss, refeeding syndrome or electrolyte disorders, etc., should be adjusted according to the actual situation.

Table 3 Recommended daily amount of micronutrients for total parenteral nutrition

Minerals and trace elements	Recommended amount	Vitamins	Recommended amount
Minerals		Vitamin B1	6 mg
Sodium / potassium	1 ~ 2 mmol / kg	Vitamin B2	3.6 mg
calcium	10 ~ 15 mEq	Vitamin B3	40 mg
magnesium	8 ~ 20 mEq	Folate	600 mcg
phosphorus	20 ~ 40 mmol	Pantothenic acid	15 mg
		Vitamin B6	6 mg
Trace elements		Vitamin B12	5 mcg
chromium	<1 mg	Biotin	60 mcg
copper	0.3 ~ 0.5 mg	Vitamin C	200 mg
manganese	55 mcg	Vitamin A	990 mcg
selenium	60 ~ 100 mcg	Vitamin D	5 mcg
Zinc	3 ~ 5 mg	Vitamin E	10 mg
		Vitamin K	150 mcg

Vitamin C: In recent years, many studies have shown that high-dose vitamin C (3 ~ 10 g / d) intravenous injection can significantly reduce mortality in critically ill patients, shorten the use of booster drugs and mechanical ventilation time, and integrate acute respiratory distress caused by viral infection Syndrome (ARDS) is also effective [15], so it is recommended that in addition to the conventional vitamin C intake for critically ill patients, intravenous high-dose vitamin C may be beneficial [8].

Vitamin D: Vitamin D deficiency is common in critically ill patients and is associated with adverse clinical outcomes, including higher mortality and infection rates, longer hospital stays, and longer mechanical ventilation. Therefore, if the blood 25 (OH) vitamin D level of critically ill patients is lower than 12.5 ng / mL or 50 nmol / L, vitamin D3 should

be supplemented, and large doses of vitamins can be given at one time after entering the ICU D3 (500 000 UI) [6] .

Phosphorus: Hypophosphatemia often occurs in critically ill patients, such as blood phosphorus ≤0.5 mmol / L, need to be vigilant about the presence of refeeding syndrome [16] . Therefore, it is recommended to closely monitor the serum phosphate concentration and to give appropriate phosphate supplements if necessary [5] .

In clinical diagnosis and treatment, the patients with new crowns are critically ill at different stages, their body metabolism changes are different, and energy and nutrient substrate requirements are also in dynamic changes. Therefore, the body's demand for nutrients should be determined according to different disease conditions, different stages and important organ functions [17] .

2.2 Nutrition treatment options and approaches for critically ill patients with new crowns2.2.1 Principles

Nutritional treatment was implemented on the principle of five-step treatment of malnutrition [18] . Each step of the nutrition intervention is: (1) diet + nutrition education, (2) diet + oral nutritional supplement (ONS), (3) total enteral nutrition (TEN), (4) partial enteral nutrition (PEN) + partial parenteral nutrition (PPN), (5) total parenteral nutrition (TPN). When the nutrition support method in the next step cannot meet the target energy requirement of 60% for 3 ~ 5 d, the nutrition support method in the previous step should be selected. For some critically ill patients, it should be adjusted according to clinical reality.

2.2.2 Oral diet

For newly crowned critically ill patients who can eat on their own and have no risk of vomiting or aspiration, oral diet should be given priority as soon as possible, and the goal is to meet 70% of nutritional requirements within 3 to 7 days [6] . Encourage patients to eat and take small meals as necessary. If the oral diet does not meet the patient's caloric goals, ONS should be given priority, followed by EN [6] . According to the specific conditions of patients, general or disease-specific ONS (such as diabetes, kidney disease preparations, etc.) can be given. The energy of 400 ~ 600 kcal is given daily through ONS to achieve the best effect of ONS. For patients with dysphagia, you can first try to reduce the risk of aspiration by changing food characteristics and other methods. If the dysphagia worsens, EN [6] should be given .

2.2.3 Enteral nutrition (EN)

EN contraindications: comprising shock uncontrolled, uncontrolled acidosis and hypoxemia, upper gastrointestinal bleeding, intestinal ischemia, obstruction, abdominal compartment syndrome and distant-feeding path high output fistula [6 , 19] . Further, hemodynamic instability or gastric retention in the blood at greater than 500 mL / 6 h, the suspension should EN [. 5] .

Indications for EN: Enteral nutrition can maintain the integrity of the intestinal barrier and function [19] , prevent gastrointestinal complications in patients with mechanical ventilation [13 , 19] , and promote intestinal immune function [13 , 20] . So, who can not eat by mouth and no contraindications EN new crown critically ill patients, should be preferred EN, EN given early in the ~ 48 H 24- [5 - 6 , 19 , 21] . Early EN is also recommended for patients receiving extracorporeal membrane oxygenation (ECMO) [22] .

Nourishing feeding of EN: Nourishing feeding (usually defined as 10-20 mL / h or 10-20 kcal / h) can prevent intestinal mucosal atrophy and maintain intestinal integrity [13] . Therefore, it is recommended that EN in patients with critically ill new

crowns cannot increase EN due to gastrointestinal intolerance or other reasons. If the situation allows, it is recommended not to stop EN completely and try to maintain nourishing EN feeding to keep the intestinal mucosa intact.

The way to implement EN: The gastric pathway (nasogastric tube) should be used as the standard way to start EN. If symptoms of gastric feeding intolerance occur and cannot be improved even after the use of gastrokinetic drugs, posterior pyloric feeding (nasal duodenum tube, nasal jejunum tube) should be used [6, 16]. High risk of aspiration, such as mechanical ventilation, especially prone ventilation, age> 70 years, use of sedatives, muscle relaxants in ECMO patients, decreased consciousness, weak pharyngeal reflexes, poor oral care, insufficient nurse-to-patient ratio, nerve Systemic defects and a history of gastroesophageal reflux can be considered directly after pyloric feeding [6, 16].

EN infusion method: Continuous infusion can significantly reduce the risk of diarrhea compared to single infusion. Therefore, continuous infusion (infusion pump) is the preferred method under certain conditions [6]. The continuous infusion started at a rate of 20 to 30 mL / h, and if there was no retention after 2 h, it increased at a rate of 10 mL / h until 60 to 100 mL / h [44]. In order to reduce the risk of aspiration pneumonia, all patients receiving EN tracheal intubation should raise the bedside by 30 ° ~ 45 °, and consider using chlorhexidine mouthwash twice a day to clean the mouth [16]. If prone position ventilation is used, enteral nutrition should be suspended from 0.5 h to 1 h before the position is inverted, and the residual amount of the stomach should be detected to avoid complications such as aspiration and suffocation due to reflux and vomiting during the inversion.

EN's formulation choices: (1) conventional formula: suitable for patients with new crowns who are not accompanied by elevated blood glucose and renal insufficiency, and normal gastrointestinal function. However, since the demand for protein in critically ill patients is higher than that for energy, conventional enteral preparations may not meet the protein demand, and protein components (whey protein powder, etc.) can be added if necessary [5]. (2) Diabetes formula: suitable for patients with diabetes or accompanied by elevated blood sugar. (3) Kidney disease formula: suitable for patients with renal insufficiency. (4) High energy density formula (1.5 ~ 2 kcal / mL): suitable for patients with capacity overload or need to control the amount of infusion [5]. (5) High dietary fiber formula: suitable for patients with persistent diarrhea without intestinal ischemia or severe gastrointestinal dysfunction. Soluble dietary fiber (fructo-oligosaccharide, inulin, etc.) can also be added to the standard formula, and 10 ~ 20 g will be given in divided portions within 24 hours [5]. (6) Short peptide formula: It is suitable for patients who give EN by nasal jejunal tube route or suffer from diarrhea due to gastrointestinal malabsorption [5]. (7) Pulmonary disease type formula (high fat / low carbohydrate): Whether severe patients with mechanical ventilation use high fat / low carbohydrate formula is still controversial. It has been thought that the use of this formula can reduce CO_2 production and reduce respiratory entropy. However, some studies have shown that when there is no overfeeding, that is, when the energy intake value is approximately equal to energy expenditure, the composition ratio of macronutrients does not affect the production of CO_2 [5, 23]. In addition, the high content of omega-6 fatty acids in this formula may drive the inflammatory process [5]. Therefore, it is not recommended to use this formula in patients with new crown critical illness [5]. (8) characterized in immunomodulatory formulations: Formulations such as adding ω-3, γ- linolenic acid, glutamine or the like, in view of conflicting research data [5-6, 24], the new crown recommended temporarily ill patients Preferred use.

Gastrointestinal complications of EN: Because neocrown virus can directly attack the gastrointestinal tract, use of antiviral drugs, sedatives and mechanical ventilation, gastrointestinal intolerance such as diarrhea, vomiting, diarrhea often occurs in critically ill patients. In severe cases, EN cannot continue. (1) abdominal distension and vomiting:

first use gastrokinetic drugs, such as metoclopramide 10 mg or erythromycin 3-7 mg / kg 3 to 4 times a day. Domperidone is not recommended because it may cause severe ventricle Tachycardia and other symptoms. After the use of gastrokinetic drugs, improvement is still not possible, and pyloric feeding (nasal-duodenal tube, nasal jejunal tube) should be adopted [6, 16]. (2) Diarrhea: slow down the infusion rate, dilute the EN formula with water to reduce the osmotic pressure, or try switching to a high dietary fiber formula or a short peptide formula and check the temperature of the nutrient solution. It is not recommended to stop EN completely due to gastrointestinal intolerance. Try to maintain nourishing EN feeding.

2.2.4 Parenteral nutrition (PN)

Contraindications for PN: When cardiovascular dysfunction or severe metabolic disorders have not been controlled and the circulation / internal environment is unstable, the implementation of PN is postponed because PN may increase the burden on the circulatory system and cause more severe metabolic disorders [4].

Indications for PN: Water and sodium retention and pulmonary edema are common in critically ill patients with new crowns. Limitation of fluid intake is very important, but PN is likely to cause fluid load. Therefore, EN is recommended. It is recommended when EN contraindication exists or EN cannot reach the target amount Use PN. (1) Total parenteral nutrition (TPN): Patients contraindicated by EN, if they already have severe malnutrition or high nutritional risk (NRS 2002 ≥ 5 points or NUTRIC score ≥ 5 points), TPN should be started as soon as possible after entering the ICU [5-.6]; if low nutritional risk (NRS 2002≤3 or NUTRIC score ≤5), ESPEN recommendation may be administered in the TPN. 7 D ~. 3 [.6], and ASPEN recommendations should be given after the TPN D. 7 [.5]. (2) Supplemental parenteral nutrition (SPN): There is evidence that early SPN administration in critically ill patients does not improve prognosis and may be harmful to patients, especially in the case of overfeeding [11]. Therefore, for patients with high nutritional risk, when EN cannot reach 60% of the target amount within 48 ~ 72 h, it is recommended to implement SPN as soon as possible [11, 44], and for patients with low nutritional risk, if EN is within 7 to 10 days SPN cannot be recommended until it reaches 60% of the target demand [5, 11].

PN implementation path: For those who need a longer period of PN supporters (≥ 2 weeks) or the body's demand for nutrients is greatly increased, central intravenous infusion should be used. For patients who are expected to have shorter (<2 weeks) PN support or patients who receive SPN (less nutrient solution infusion), they can be infused via peripheral veins. At the same time, the maximum tolerable osmotic pressure of peripheral veins is 900 mOsm / L [13].

PN infusion method: (1) All-in-one preparation: It is recommended to use all-in-one preparation instead of multi-bottle infusion. For hospitals without a parenteral nutrition allocation center, commercial multi-chamber bags are preferred [10]. (2) Glucose infusion: The initial rate of glucose infusion in critically ill patients in the new crown does not exceed 5 mg / kg per minute [6]. Beyond this dose, oxygen consumption increases and CO_2 production increases, especially for such patients who are prone to respiratory insufficiency. (3) Fat emulsion infusion: When the blood triacylglycerol level is> 4 ~ 5 mmol / L, the fat emulsion should be banned; when the blood triacylglycerol level is 2 ~ 2.5 mmol / L, the fat emulsion should be used with caution. Fat emulsion infusion too fast (> 3 mg · kg $^{-1}$ · min $^{-1}$) will lead to worsening lung function, so the infusion time should be ≥8 h [4], especially in the first few days of use, the infusion rate should be as slowly as possible (e.g., including LCT infusion should kg · G ≦ 0.1 $^{-1}$ · H $^{-1}$ [.4] ≤0.15 when G · kg, the infusion containing a fat emulsion mixed MCT≤40% $^{-1}$ · H $^{-1}$). Fat emulsions cannot be infused directly through the ECMO line, but should be infused through a separate intravenous channel.

PN's immune preparations: (1) omega-3 fatty acids: see 2.1.3 for details; (2) glutamine: new crown severe patients are in an acute stress state, the body's catabolism is intensified, and glutamine is consumed in large quantities, so in theory Glutamine supplementation can protect the intestinal mucosal barrier function, prevent mucosal atrophy and the intestinal bacteria and toxins caused by translocation. Early studies have often shown that intravenous glutamine can reduce mortality, but subsequent meta-analysis has shown that patients given intravenous glutamine preparations have significantly increased mortality [5] . Therefore, glutamine should be used with caution in critically ill patients. (3) Arginine: Arginine is a semi-essential amino acid. Under stress conditions such as infection and trauma, arginine is beneficial to the body's protein synthesis, reduces urea nitrogen excretion, and improves nitrogen balance [28] . However, recent meta-analyses suggest that arginine supplementation significantly increases CRP in the elderly, oncology patients, and patients with elevated underlying CRP [29] . Therefore, arginine is not recommended for critically ill patients with new crowns.

Discontinuation of PN: For patients implementing PN stabilization, try to make the transition to EN when the gastrointestinal tract is available. It can start with nourishing feeding, and as EN tolerance improves, when EN can provide more than 60% of the target energy requirement, the PN dose can be gradually reduced and eventually discontinued [5] .

3 Nutritional surveillance for critically ill patients

During enteral or parenteral nutrition interventions, the effects of nutritional support and related adverse reactions should be dynamically monitored, including the following.

(1) Completion of nutrition programme: including oral eating, enteral nutrition and parenteral nutrition.

(2) Biochemical indicators: such as blood routine, liver function, kidney function, electrolytes, blood glucose, blood lipids, etc.

(3) Anthropometric: such as body mass.

(4) Gastrointestinal symptoms: such as diarrhea, bloating, abdominal pain, and vomiting.

(5) Others: such as gastric residual volume, intra-abdominal pressure, bowel sounds, and volume of fluid in and out (24-hour fluid volume in and out, 3 to 5 d dynamic volume of fluid volume in and out) and so on.

Frequency and specific monitoring program monitoring recommendations refer to Table 4 [5 , 30 - 31 is] .

Table 4 Nutrition monitoring items and recommended monitoring frequencies

Monitoring category	Point description	Recommended frequency
Nutrition program completion (oral eating, enteral nutrition, parenteral nutrition)	Assess actual nutrient intake, adjust unreasonable nutrition plans in time, and promote a smooth transition between the five steps.	1 time daily.
Biochemical Indicators		

Monitoring category	Point description	Recommended frequency
Blood routine, liver and kidney function	Albumin and prealbumin in liver function are commonly used nutritional indicators, and conditions can be monitored such as transferrin, retinol binding protein and other indicators.	Routine can be 1 to 2 times a week, and those with liver and kidney failure will increase the frequency accordingly.
Electrolyte	Including blood phosphorus, blood potassium, blood calcium, blood sodium, blood magnesium, blood chlorine, etc .; electrolytes need to be monitored before and during nutritional support to prevent refeeding syndrome; PN support and CRRT treatment need to strengthen monitoring.	Monitor once every 1-2 days.
blood sugar	Both hypoglycemia and hyperglycemia are associated with poor prognosis and mortality, and patients with diabetes need to be monitored especially.	Feeding starts every 4-6 hours within 24 hours of feeding, and at least twice daily during the later period. People with unstable blood sugar should be more frequent.
Blood lipids	Including triacylglycerol, cholesterol and so on.	2 times a week.
Body mass measurement	It is used to help judge the effect of nutrition intervention; BMI <18.5 kg / m^2 , indicating the presence of malnutrition.	Once a week.
Gastrointestinal symptoms		
Bowel sounds, diarrhea, bloating, abdominal pain, nausea, vomiting, reflux, etc.	Reflect EN-supported gastrointestinal tolerance.	1 time daily.

Monitoring category	Point description	Recommended frequency
Gastric residue (GRV)	Used to assess gastrointestinal dysfunction and tolerance to EN support, to prevent reflux and aspiration. For short-term drainage (such as 15 min), GRV> 250 mL is considered to have a high residual amount. Patients with GRV> 500 mL / 6 h are recommended to give prokinetic drugs or consider nasal jejunal tube feeding. Delayed enteral nutrition is used for those who do not improve.	High-risk patients are advised to monitor every 4-6 hours.
other		
Intra-abdominal pressure (IAP)	Intra-abdominal pressure is related to EN tolerance, and the use of enteral nutrition with IAP greater than 20 mmHg will be limited. EN speed and dosage should be adjusted according to intra-abdominal pressure.	For patients with ARDS mechanical ventilation, it is recommended to use it every 4-6 hours.
Volume of liquid in / out (24 h volume of liquid in / out, 3 ~ 5 d dynamic volume of liquid in / out)	Understand fluid balance in the body and guide fluid replacement and nutrition programs.	24 h in / out volume: 1 time per day; 3 ~ 5 d dynamic in / out volume balance: 1 time every 3 ~ 5 d.

4 Nutrition treatment for critically ill children with new crown

The nutritional treatment of children with new type of critically ill children (28 d ~ 18 years old) is basically similar to that of adults, with a slight difference: the Schofield formula can be used to determine the energy target amount, and it can also refer to children 1 to 8 years old at 50 kcal / kg or 5 to 12-year-old children with 880 kcal / d as the reference target value of estimated energy expenditure in the acute phase [39-40] ; the target amount of protein is 1.5 g / kg per day. For infants and young children, a higher amount of protein may be required to achieve positive Nitrogen balance [39-40] ; short peptide formulations are more common for EN preparations in critically ill children.

Writing: Zhang Jiaying, Shao Chunhai, Yang Jiahong, Su Jianguang, Qian Tian

Review: Liu Jingfang, Chen Wei

Writing expert group members:

Chen Wei (Department of Clinical Nutrition, Peking Union Medical College Hospital), Liu Jingfang (Department of Clinical Nutrition, Huashan Hospital Affiliated to Fudan

University), Rao Zhiyong (Department of Clinical Nutrition, West China Hospital of Sichuan University, assisted by Wuhan Wuchang Hospital), Cai Jun (Longhua Affiliated to Shanghai University of Traditional Chinese Medicine) Department of Clinical Nutrition, Hospital), Zhang Ming (Department of Clinical Nutrition, Peking University Shenzhen Hospital), Han Lei (Department of Clinical Nutrition, Affiliated Hospital of Qingdao University), Li Li (Department of Clinical Nutrition, First Affiliated Hospital of Xinjiang Medical University), Shao Chunhai (Fudan University) Department of Clinical Nutrition, Huashan Hospital Affiliated to Huashan Hospital), Zhang Jiaying (Department of Clinical Nutrition, Huashan Hospital Affiliated to Fudan University), Yang Jiahong (Department of Clinical Nutrition, Huashan Hospital Affiliated to Fudan University), Su Jianguang (Department of Clinical Nutrition, Huashan Hospital Affiliated to Fudan University), Qian Tian (Affiliated to Fudan University Department of Clinical Nutrition, Pediatric Hospital), Lu Dongmei (Department of Clinical Nutrition, Huashan Hospital Affiliated to Fudan University), Tian Fang (Department of Clinical Nutrition, Huashan Hospital Affiliated to Fudan University), Zhou Yan (Department of Critical Medicine, Huashan Hospital Affiliated to Fudan University), Wuhan Tongji Hospital Guanggu Hospital Intensive Care Unit), Zhang Jing (Nursing Department, Huashan Hospital, Fudan University, assisted Wuhan Tong Department of Intensive Care, Guanggu District, Ji Hospital), Tang Min (Department of Gastroenterology & Clinical Nutrition, Fourth Affiliated Hospital of Anhui Medical University), Wu Jiang (Department of Clinical Nutrition, Xinhua Hospital, Shanghai Jiaotong University School of Medicine), Xu Renying (Shanghai Jiaotong University Department of Clinical Nutrition, Renji Hospital, Medical College), Wu Jing (Department of Clinical Nutrition, Chen Xinghai Hospital, Zhongshan City, Guangdong Province), Liu Zhen (Department of Clinical Nutrition, Yingtan People's Hospital, Jiangxi Province), Geng Feng (Severe Illness, Wuhan Central Hospital, Hubei Province) Medicine)

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