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Выбор смеси для энтерального питания у пациентов в остром периоде тяжёлого состояния с повреждением головного мозга в отделении нейрореанимации

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АННОТАЦИЯ

Нутритивная поддержка является важной и неотъемлемой частью лечебного процесса для пациентов в интенсивной терапии. По причине тяжести состояния пациенты после нейрохирургических вмешательств и пациенты с повреждением центральной нервной системы, например вследствие острого нарушения мозгового кровообращения, могут находиться в отделении интенсивной терапии. Проведение нутритивной поддержки данной категории пациентов имеет свои особенности. Энтеральное питание, как наиболее физиологичный вид питания, должно являться неотъемлемой частью лечебного процесса в отделении интенсивной терапии. У пациентов, находящихся в остром периоде тяжёлого состояния с повреждением головного мозга, к метаболическому ответу на повреждение добавляются также факторы, лимитирующие проведение энтерального питания: собственно повреждение головного мозга, нахождение в интенсивной терапии и методы интенсивной терапии. Выбор смеси для энтерального питания у данной категории пациентов является сложным и основополагающим для проведения адекватной нутритивной поддержки с покрытием потребностей в энергии и белке. В данном научном обзоре освещаются вопросы выбора смеси для энтерального питания пациентов отделения нейрореанимации, находящихся в остром периоде тяжёлого состояния.

Ключевые слова: нутритивная поддержка; повреждение головного мозга; нейрореанимация; энтеральное питание; интенсивная терапия; смесь для энтерального питания.

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The choice of enteral formula in patients in the acute period of critical ill with brain damage in the neurocritical care unit

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ABSTRACT

Nutritional support is an important and integral part of the treatment process for critically ill patients. Patients after neurosurgical interventions and patients with damage to the central nervous system, for example, due to acute ischemic stroke, may be due to the severity of the condition in the intensive care unit. This is a separate category of patients and nutritional support for this category of patients has its own characteristics. Enteral nutrition, as the most physiological type of nutrition, should be an integral part of the treatment process in the intensive care unit. In patients in the acute period of a severe condition with brain damage, in addition to the metabolic response to damage, there are also factors that limit the implementation of enteral nutrition: the brain damage itself, being in intensive care, and methods of intensive therapy. The choice of an enteral formula in this category of patients is complex and fundamental to provide adequate nutritional support to cover energy and protein requirements. The purpose of this scientific review is to highlight the issues of choosing a mixture for enteral nutrition of patients in the neurocritical care unit who are in the acute period of a critical ill.

Keywords: nutritional support; brain damage; neurocritical care; enteral nutrition; intensive therapy; enteral formula.

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INTRODUCTION

Nutritional support is an important and integral part of the treatment process for patients in intensive care. Adequate nutritional support reduces the number of infectious complications, ventilatory days, ICU days and the overall hospital stay [1]. A number of studies have shown that adequate nutritional support also reduces mortality [2].

Patients after neurosurgery and patients with damage to the central nervous system, e.g. due to an ischemic stroke, may be hospitalized in the intensive care unit. This is a different category of patients. The management of nutritional support in these patients has its own peculiarities.

Selecting an enteral feeding formula for a general surgical patient in the intensive care unit is always a challenge, as the normal functioning of the gut in this category of patients is disrupted by the surgery itself [3]. When comparing general surgical patients in the ICU with neurocritical care patients, it seems that the choice of enteral feedings for the latter is relatively straightforward, in contrast to that for general surgical patients. However, in addition to the metabolic changes common to all ICU patients in response to critical illness, gastrointestinal dysfunction is also common in neuroICUs, which significantly limits the use of enteral feeding and requires an individualised approach to enteral feeding [4].

This scientific review highlights the choice of enteral feeding formula for neurocritical care patients in the acute period critical illness.

ENTERAL NUTRITION AS AN IMPORTANT AND INTEGRAL PART OF THE TREATMENT PROCESS FOR PATIENTS WITH BRAIN INJURY

Enteral nutrition should be an integral part of the treatment process in the intensive care unit.

Enteral nutrition can be roughly divided into oral nutritional support (ONS), and enteral tube feeding, where nutritional support is provided with specialized enteral formula through an oro-, nasogastric tube, gastrostomy or jejunostomy.

The current European guidelines on nutritional support for patients in the ICU recommend starting with oral nutrition whenever possible [5].

For patients in the neurocritical care unit, given the severity of their condition and their often decreased level of consciousness, the use of oral enteral feeding is usually not possible.

Specialized guidelines for nutritional support of patients in the neurocritical care unit were not found. However, from both international and domestic guidelines for nutritional support of patients in the acute period of critical illness, it follows that energy requirements this category of patients should be determined by indirect calorimetry, if it is impossible — at the rate of 25–30 kcal/kg/day and not less than 1.2 g of protein per 1 kg body weight per day [5–7]. Recommendations differ slightly with regard to the amount of protein to be delivered to patients in intensive care. Some guidelines suggest 1.2–1.5 g/kg/day [6], others suggest up to 2 g/kg/day [7], and the European Association for Clinical Nutrition and Metabolism guidelines suggest at least 1.3 g/kg/day or more [5]. However, the average recommended protein dose is at least 1.2 g/kg/day.

It follows from the guidelines that, with a relatively low energy requirement, significantly higher protein doses are required. However, after 4–7 days, actually after the patient's condition has stabilised, both a high energy content and a high protein content are required [8].

Most publications and guidelines, both foreign and Russian, recommend starting nutritional support with enteral feeding [5–7]. Why is this important? Enteral feeding is the most physiological way of providing nutritional support. Early and correctly administered enteral feeding leads to a reduction in infectious complications and improved outcomes [9]. These enteral feeding effects are a consequence of gastrointestinal physiology. The lumen of the gastrointestinal tract contains a large number of bacterial flora, presented as both symbionts and opportunistic flora [10]. A number of studies have found that the critical illness leads to a shift in the gut microbial landscape towards pathogenic flora after only a few hours in the intensive care unit [11,12]. This condition is exacerbated by the ongoing intensive care, which often includes antibiotics, opioid analgesics and proton pump inhibitors [13–15].

The barrier separating the bacterial microbiocenosis in the lumen of the gastrointestinal tract and the bloodstream is the tight contacts between the cells of the intestinal epithelium. The human gastrointestinal tract, including the cells of the intestinal epithelium, receives nutrition from the food lump that follows a transit through its lumen [16]. Intestinal microflora, also fed by the food lump, enable modulation of immune responses and maintenance of intestinal mucosal homeostasis [17]. A prolonged absence of nutrition in the gastrointestinal lumen compromises the barrier function of the intestine and alters the composition of the microbiome, leading to bacterial translocation and, consequently, to an increase in infectious complications and even sepsis [18–20]. Therefore, early and adequate enteral feeding, especially in patients with brain injury, in the neurocritical care unitis an important and indispensable method of intensive care to improve outcomes [21].

GASTROINTESTINAL DISTURBANCE IN PATIENTS WITH BRAIN DAMAGE

Although enteral nutrition is the preferred way of providing nutritional support to patients in the ICU, it is often difficult to achieve the goals of energy and protein delivery

alone. A patient in the acute period of severe condition develops gastrointestinal dysfunction. Severe conditions and the patient's presence in the intensive care unit itself cause gastrointestinal dysfunction. and lead to disruption of the microbial landscape in the intestinal lumen [22].

While for patients who have undergone gastrointestinal surgery, gastrointestinal dysfunction is predictable and to be expected, for patients with central nervous system damage the causes of such dysfunction are not obvious. However, they do exist and are caused by the disruption of the central nervous system itself.

The barrier and contractile functions of the gastrointestinal tract as well as the intestinal microbiocenosis are impaired. Bansal et al. showed that traumatic brain injury stimulates an increase in the permeability of the intestinal wall, the mechanism of which is not fully understood. It is possible that expression of ZO-1 and occludin proteins in tight contacts may be decreased after craniocerebral trauma, leading to their damage [23]. A study by Olsen et al. showed that traumatic brain injury causes a delayed but significant decrease in intestinal contractile activity in the ileum, resulting in delayed transit. Reduced intestinal motility activity is attributed to secondary inflammatory damage, as evidenced by increased activity of the transcription factor kappa B (Nuclear factor kappa B), increased swelling and increased inflammatory cytokines in the intestinal smooth muscle [24]. A stay in the ICU leads to a shift of the gut microbial landscape towards pathological flora [11–12]. The development of dysbiosis, with a shift towards pathological flora, leads to bacterial invasion and bacterial translocation (25), and these disorders are exacerbated with the length of stay in the ICU [26–29]. A number of studies show that brain and spinal cord injury result in the same disruption of the gut microbial landscape [30–31].

Drugs used to treat patients with brain damage in the neuroreanimation unit, such as proton pump inhibitors, opioid analgesics, sedation and anaesthetic drugs, and catecholamines to maintain normal average blood pressure levels, also lead to gastrointestinal disturbances and disruption of the gut microbiome.

ENTERAL FEEDING MIXES

Current recommendations are that nutritional support should start with oral intake, or if this is not possible, with enteral feeding for 48 hours [5, 6].

Enteral feeding should be started gradually during the initial period of critical condition, reaching a calculated volume by day 4–7 [5].

A large number of enteral feeding formula are now available, usually differing in chemical composition, physical properties and energy and protein content (Table) [32].

Liquid, ready-to-use enteral feeding formulas are now used for simplicity, convenience and safety in the intensive care unit [33].

Partially oligomeric protein hydrolysate-based enteral feeding formulas are easily absorbed, so their use in the acute period of severe condition is most preferable in the early phase [34]. As the patient stabilizied and progresses from the early to the late acute phase, polymeric formulas should be used.

In all cases, hypercaloric hypernitrogenic formulas should be used in order to effectively support the patient

Table. Classification of enteral feeding formulas

Classification	Type of formula
In terms of chemical composition	Polymeric (complete). Oligomeric. Metabolically directed (e.g. in diabetes mellitus). Modular. Enriched with or without dietary fibres
In terms of energy content	Isocaloric (1 ml=1 kcal). Hypercaloric (1 ml >1 kcal). Hypocaloric (1 ml <1 kcal)
In terms of protein content	Isonitrogenic (3.5–5.0 g/100 ml). Hyponitrogenic (<3.5 g/100ml). Hyprenitrogenic (>5 g/100 ml)
By osmolarity	Isoosmolar (280–310 mOsm/l). Hypo-osmolar (less than 280 mOsm/l). Hyperosmolar (more than 310 mOsm/l)
In terms of physical properties	Liquid, ready to use. Powdered

with all the necessary nutrients in the right amounts according to current guidelines, while avoiding volume and energy overload, especially in the early period, and delivering sufficient protein.

So-called pro-inflammatory diets are also known to shift the gut microbiome towards pro-inflammatory flora, which in turn stimulates inflammation [25, 35]. It has been suggested that the gut is the 'driver' of multiple organ failure syndrome in critical conditions due to complex interactions between the intestinal epithelium and the immune system [36–39]. The modulation of the systemic inflammatory response to the critical condition requires the presence of omega-3 fatty acids in adequate amounts in the enteral feeding mixture.

Dietary fibre mixes are best used already in the rehabilitation phase because of their poor tolerability in the acute period, especially if the patient requires vasopressor support, due to a shift of the gut microbiome in the pathological direction [11, 12, 40].

The concept of 'standard enteral feeding formula' has changed considerably in recent years. Previously, an isocaloric isonitrogenic enteral feeding mixture was considered standard [41]. This is not the case for intensive care patients, given the current guidelines [42]. Currently, the standard enteral feeding formula for patients in the intensive care unit, including patients in the neurocritical care unit, is a hypercaloric hypernitrogenic formula without fibre.

Enteral feeding formulas for nutritional support of patients in the intensive care unit, including patients in the neurocritical careunit, should vary according to the phase of the metabolic response to stress from a moderate hypercaloric hypernitrogenic partially oligomeric formula without fibre in the early phase to a hypercaloric hypernitrogenic polymeric formula without fibre in the late phase.

CONCLUSION

The choice of an enteral feeding formula for a patient in a neurocritical care unit is an important component of adequate nutritional support. The choice of the formula and its individual adaptation to the phase of metabolic response to stress [5] is crucial for the adequacy and completeness of the enteral feeding given that the patient's ability to consume enteral nutrition in full on their own is limited.

The mixture should be selected on the basis of the patient's phase of metabolic response to trauma and stress. Selection should be based on indirect calorimetry data or at 20–25 kcal/kg/day and at least 1.2 g protein per 1 kg body weight per day with moderately hypercaloric (1,2 kcal/kg/day) hypernitrogenic (10 g/100 ml) partially oligomeric formula on the basis of protein hydrolysate without fibre with change over to enteral feeding at the rate of 25–30 kcal/kg/day and not less than 1.2 g of protein per 1 kg of body weight daily with hypercaloric (1.5–2.0 kcal/ml) polymeric formula without fibre. The addition of fibre to this formula is possible during the rehabilitation phase.

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