

ENTERAL NUTRITION IN SEPSIS: CAN WE BREAK THE MYTH?

Milena Stojanović

Sepsis is a complex disorder that occurs as a result of the host's inadequate response to infection, and it is associated with acute organ failure and a high mortality rate. Over the past 30 years lot of research has been conducted in this field, which resulted in a faster recognition of the septic patient by using adequate scores and changing the existing ones. Septic shock is defined as hypotension despite adequate fluid resuscitation, therefore requires vasopressor support and is accompanied by circulatory, metabolic and cellular abnormalities.

Sepsis and septic shock are typically associated with catabolic stress, where patients exhibit a systemic inflammatory response associated with complications such as multiorgan dysfunction, morbidity, prolonged hospitalization and death. Malnutrition is common in septic patients, taking into account pronounced catabolism in the early phase. In septic patients, enteral nutrition can be important for covering the energy requirements. Early nutrition therapy, primarily by enteral route, is today seen as a proactive therapeutic strategy with the aim of reducing the severity of the disease, complications, length of hospital stay and positive outcome of the patient.

Enteral nutrition should not be started in patients who are hypotensive (MAP < 50 mmHg), in whom treatment with vasopressors has just started or in whom there is an escalation of vasopressor doses. According to recommendations, enteral nutrition should be withheld until hemodynamic stability is achieved. The risks and benefits of enteral nutrition must be considered for each patient in the state of septic shock. Noradrenaline dose of < 0.3 mcg/kg/min can be considered safe, and such patients can be characterized as hemodynamically stable.

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Introduction

Sepsis is a complex disorder that occurs as a result of the host's inadequate response to infection, and it is associated with acute organ failure and a high mortality rate (1). It is a very important health problem and requires urgent recognition and treatment because any delay reduces the survival rate. Over the past 30 years lot of studies and research have been conducted in this field, which resulted in a faster recognition of the septic patient by using adequate scores and changing the existing ones (2, 3). In 2017, the

World Health Organization declared sepsis a health priority and adopted the Resolution concerning the improvement of prevention, diagnosis and treatment (4).

Starting in 1992, the definition of sepsis underwent many revisions, since it was then defined as an inflammatory response to infection. The clinical diagnosis was based on 2 or more criteria (hypo/hyperthermia, leukocytosis/leucopenia, heart rate > 90/min, respiratory rate > 20/min) of Systemic Inflammatory Response (SIRS) with a suspected or confirmed source of infection (5). At that time, septic shock was defined as persistent hypotension and hyperlactatemia refractory to fluid resuscitation. Considering that these definitions lacked both sensitivity and specificity, in 2001, a criterion for organ dysfunction evaluation (SOFA) score was introduced, which indicated severe sepsis (6).

After about two decades, in 2016, the Third International Consensus on the Definition of Sepsis and Septic Shock defined sepsis as a life-threatening organ dysfunction which occurs as a result of an inadequate host response to infection, and septic shock as sepsis accompanied by circulatory, metabolic and cellular abnormalities (7). Clinically, shock is defined as persistent

hypotension accompanied by MAP < 65 mmHg and increased serum lactates > 2 mmol/L after fluid resuscitation. Also, septic shock is accompanied by a higher mortality rate, of 40%, which is in the case of sepsis about 10% (1).

The importance of nutrition in hospital conditions should not be neglected. Critical illness, including sepsis and septic shock, is typically associated with catabolic stress where patients exhibit a systemic inflammatory response associated with complications such as multiorgan dysfunction, morbidity, prolonged hospitalization and death. Malnutrition is common in septic patients, taking into account pronounced catabolism in the early phase. In this case, enteral nutrition (EN), which delivers nutrients into the digestive system, can be important for covering the energy requirements of these patients (8).

In the last three decades, great progress has been made in understanding the molecular and biological effects of nutrients in maintaining homeostasis in critically ill patients. Traditionally, nutrition support meant an additional form of treatment and patient care with the goal of providing enough energy to maintain lean body mass. Recently, this type of therapy has been called *nutritional therapy*, which implies support in maintaining a normal metabolic response to stress, prevention of oxidative cell damage and positive impact on immune response (9).

Early nutrition therapy, primarily by enteral route (EEN), is today seen as a proactive therapeutic strategy with the aim of reducing the severity of the disease, reducing complications, length of hospital stay and positive outcome of the patient.

Based on experts' opinions, comorbidities, the condition and function of the digestive system, as well as the risk of aspiration, should be taken into account within the nutrition assessment. Traditional serum markers, albumin, prealbumin, transferrin, retinol-binding protein, as indicators of the acute inflammatory phase, are no longer recommended in the Intensive Care Unit (ICU) (10). For determining energy requirements, indirect calorimetry is an option whenever it is available. If it is not available, ESPEN (European Society for Parenteral and Enteral Nutrition), ASPEN (American Society for Parenteral and Enteral Nutrition) and SCCM (Society for Critical Care Medicine) recommend to use predictive equations based on patient's body weight (25–30 kcal/kg/day) (9, 11, 12).

The most important macronutrients are proteins, necessary for wound and anastomoses healing, to support the immune system and maintain the lean body mass. For the majority of critically ill patients, the need for proteins is greater than daily energy requirements, and they often cannot be met with EN only, especially in the first days of illness. Patients with frequent interruption of EN may benefit from protein supplementation. Daily needs of protein are about 1.2–2 gr/kg/day (9, 11, 12).

Recommendations for starting early EN are within 24–48 h of admission in the ICU (9, 11, 12). Enteral nutrition maintains the integrity of the gastrointestinal tract and strong junctions between epithelial cells, promotes blood flow through mucosa, stimulates the trophic factors release (cholecystokinin, gastrin, bombesin and bile salts). It also stimulates the secretion of IgA (13–15).

Patients with septic shock are a special group of critically ill patients and EN in these patients is recommended with great caution. The reason lies in the fact that early EN may lead to additional hemodynamic instability and can be the cause of mesenteric ischemia and necrosis (9). In the early phase of shock, the blood flow is directed from splanchnic circulation to the vital organs, such as the brain, heart and lungs. This can result in intestinal dysfunction, which is considered to be the key in the development of sepsis-mediated multiorgan dysfunction by increasing the permeability of intestinal mucosa, bacterial translocation and systemic inflammation (16). Splanchnic hypoperfusion and inadequate oxygen utilization in cells result in significant pathophysiological disorders in the digestive tract (enterocyte necrosis, overgrowth of pathogenic bacteria and their dislocation into the systemic circulation and disruption of local immune response), which can be additionally enhanced by reperfusion and use of vasopressors (17–19). High doses of vasopressors can increase the already existing high metabolic and energy needs of endothelial cells (20–22). In septic patients, there is a subclinical ischemic/reperfusion damage as a result of intestinal microcirculation disorders. Intestinal ischemia due to the use of EN is very rare but can be unrecognized and fatal (23). Retrospective studies in patients who are on stable doses of vasopressors have shown that early EN reduces length of hospital stay and mortality compared to late EN (24).

Enteral nutrition should not be started in patients who are hypotensive (MAP < 50 mmHg), in whom treatment with vasopressors has just started or in whom there is an escalation of vasopressor doses. In these patients, signs of feeding intolerance should be especially monitored, and if they are present, the dose of EN should be reduced or discontinued (9).

According to recommendations, enteral nutrition should be withheld until hemodynamic stability is achieved (11, 25, 26). It is necessary to define hemodynamically stable and unstable patients, because EN increases cardiac output, decreases systemic vascular resistance and increases mesenteric blood flow. The concept of early EN implies the use of EN within 72 h, and even 48 h of admission. It is reasonable to continue EN in patients who are on stable doses of vasopressors, assuming the patient is hemodynamically stable and the MAP is > 70 mmHg (27). Current evidence and experts' opinions suggest that the shock is not a contraindication for enteral nutrition (9, 27). It is

recommended to start with lower doses of EN in patients with a controlled state of shock and who are on low or moderate doses of vasopressors (27, 28). However, the exact doses of vasopressors are not clearly defined in clinical practice.

Although clinical studies have shown the benefits of EN, the risk and benefit in patients with shock must be rationally evaluated. Enteral compared to parenteral nutrition lowers the risk of infection and length of hospital stay (29, 30). However, the FRANS study showed that providing large amounts of macronutrients during the early phase of ICU stay can have a negative impact (31). Studies NUTRIREA 2 and NUTRIREA 3 provided evidence in terms of reducing the risk of introducing EN in patients with shock, but early EN in hemodynamically unstable patients could have a negative impact on patients' outcome (32, 33). This may be due to the fact that hyperinflammation, oxidative stress and mitochondrial dysfunction are present in the early stage of septic shock, while in the other hand, EN requires an increase of blood flow through gastric mucosa and can worsen an already existing poor visceral perfusion that accompanies the state of shock (34). Therefore, in patients who are hemodynamically stable and without need for vasopressor escalation, EN should be started by providing 20–50% of the estimated energy requirements and gradually increased while monitoring the tolerance of the gastrointestinal tract of each patient.

Enteral nutrition should start with small, trophic doses (10–20 ml/h or 500 kCal/day) and gradually increase the dose by the end of the first week. Trophic nutrition is sufficient to prevent atrophy and apoptosis of enterocytes and maintain the integrity of the gastric mucosa. It is necessary to provide 50–60% of energy needs in order to reduce the permeability of the gastrointestinal mucosa and systemic inflammation. Using gastric residual volume (GRV) as a sign of intolerance is still controversial; generally, it is not recommended. If it is used in some ICUs, the guidelines recommends delaying EN if GRV is above 500 ml/6h (9, 11).

Risk Assessment of Early EN in Patients with Septic Shock

In patients with shock who are on vasopressors, early EN can additionally worsen already existing gastrointestinal dysfunction and even lead to non-occlusive mesenteric ischemia or intestinal necrosis. Use of catecholamines during EN is a risk factor for intolerance (35). Use of sedatives, opiates, hyperglycemia, increased IAP (intra-abdominal pressure) and increased lactate levels are some of the additional risk factors for intolerance (36). These factors should be carefully considered when deciding to initiate EN in patients

on vasopressors. The risk of non-occlusive mesenteric ischemia is greater when vasopressors are combined with inotropes (37–39).

Safe Threshold Doses of Vasopressors for Initiating Early EN

The German Nutrition Association suggests that EN can be harmful when the doses of noradrenaline are greater than 0.5 mcg/kg/min (28). When using the vasopressor score, ASPEN recommends that if it is > 12, only trophic doses should be provided (9, 40). However, this score has not been proven in clinical practice.

Noradrenaline has little effect on intestinal perfusion (41), but it can lead to flow redistribution. In animal models, it has been shown that microcirculation through the superior mesenteric artery, jejunum and pancreas is reduced during the infusion of noradrenaline and adrenaline (42). Adrenaline has also been proven to disrupt gastrointestinal perfusion in patients with shock (43). Otherwise, some authors believe that flow can be increased by increasing the cardiac output (44). The effect of dopamine depends on the dose. Lower doses increase and higher decrease flow through the gastrointestinal mucosa (45, 46). Dobutamine increases (46–49) while vasopressin decreases flow (50, 51).

By searching the data, it is indicated that starting EN is safe if noradrenaline doses are < 0.3 mcg/kg/min (50). Studies NUTRIREA 2 and NUTRIREA 3 suggest a threshold of 0.5 mcg/kg/min (32, 33). For now, the safe doses of vasopressors remain a matter of debate. It is important to emphasize that the state of shock is not a contraindication for starting EN. The risks and benefits of enteral nutrition should be considered for each patient in the state of septic shock. Noradrenaline dose of < 0.3 mcg/kg/min can be considered safe, and such patients can be characterized as hemodynamically stable (9, 27).

Conclusion

Sepsis and septic shock are not contraindications for the initiation of enteral nutrition. This type of nutrition is essential in maintaining homeostasis, integrity and function of the gastrointestinal tract. For now, there is not enough evidence to support clear benefits of early compared to delayed enteral nutrition. The complex effects of vasopressors on the gut must be considered when deciding when and at what doses of nutrients should be started. A norepinephrine dose < 0.3 mcg/kg/min is considered safe for starting EN in patients with septic shock. The risks and benefits of early EN should be weighed carefully for each critically ill patient.

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Pregledni rad

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doi: 10.5633/amm.2025.0210**ENTERALNA ISHRANA U SEPSI: DA LI MOŽEMO DA
RAZBIJEMO MIT?***Milena Stojanović*

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Sepsa je kompleksan poremećaj koji nastaje kao posledica neadekvatnog odgovora domaćina na infekciju i povezuje se sa akutnom disfunkcijom organa i visokim stepenom smrtnosti. Budući da je velik broj istraživanja u poslednjih trideset godina bio posvećen sepsi, upotrebom adekvatnih skorova i menjanjem postojećih omogućeno je brže prepoznavanje pacijenata sa sepsom. Septički šok se definiše kao perzistentna hipotenzija, refraktorna na nadoknadu tečnosti, koja zahteva upotrebu vazopresora, a praćena je cirkulatornim, metaboličkim i ćelijskim poremećajima.

Sepsa i septički šok povezani su sa kataboličkim odgovorom na stres, koji karakteriše sistemski inflamatorni odgovor praćen komplikacijama poput multiorganske disfunkcije, morbiditeta, produženog bolničkog lečenja i smrti. Malnutricija je, s obzirom na izraženi katabolizam u akutnoj fazi, česta pojava kod pacijenata sa sepsom. Enteralna ishrana je važna za podmirivanje energetske potrebe ovih pacijenata. Rana ishrana, prvenstveno enteralnim putem, danas se posmatra kao proaktivna terapijska strategija koja ima za cilj redukovanje težine bolesti, smanjenje komplikacija i dužine bolničkog lečenja i postizanje pozitivnog ishoda samog lečenja.

Sa enteralnom ishranom ne treba počinjati kod pacijenata sa hipotenzijom (MAP < 50 mmHg), kod kojih je tek započeta upotreba vazopresora ili kod kojih je povećana doza vazopresora. Preporučuje se da se enteralna ishrana zaustavi do hemodinamske stabilizacije. Rizici i benefiti enteralne ishrane moraju se uzeti u obzir kod svakog pojedinačnog pacijenta u stanju septičkog šoka. Noradrenalin u dozi < 0,3 mcg/kg/min smatra se bezbednim, a pacijent kome je data ova doza noradrenalina može se okarakterisati kao hemodinamski stabilan.

*Acta Medica Medianae 2025; 64(2):92–97.***Ključne reči:** sepsa, septički šok, enteralna ishrana, vazopresori, noradrenalin

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