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Critical Care [ALERT]

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SPECIAL FEATURE

Intensive Care Enteral Nutrition in 2017

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Dr. Chen reports no financial relationships relevant to this field of study.

Enteral nutrition (EN), defined as any method of feeding that uses the gastrointestinal (GI) tract (including oral feeding), usually refers to the delivery of nourishment to the GI tract through a tube. Nutrition is of utmost importance for patients suffering from a critical illness, and EN is a mainstay of nutrition in the ICU. Malnutrition and nutritional risk are common in patients admitted to the ICU. The presence of critical illness causes the body to enter a catabolic state, putting patients at risk of development or worsening of malnutrition. The Society of Critical Care Medicine and the American Society for Parenteral and Enteral Nutrition have published and revised joint guidelines to offer evidence-based recommendations for how best to feed critically ill patients. The body of evidence continues growing, with an update to prior guidelines from 2009,[1,2] published in 2016 both in *Critical Care Medicine* and the *Journal of Parenteral and Enteral Nutrition*.[3,4] Many recommendations are based on expert consensus or "low-quality" evidence, which speaks more to the challenges in performing high-quality studies on extremely varied critically ill populations rather than the quality of the guidelines and should not deter clinicians from adhering to the guidelines.

CONSIDERATION OF ENTERAL NUTRITION

EN should be considered in any patient admitted to the ICU with nutritional risk. A full assessment of nutritional risk should be performed on all patients admitted to the ICU using a validated assessment tool that accounts for disease severity, such as the NRS 2002 or the NUTRIC.[5] The NUTRIC score includes age, APACHE II, SOFA, number of comorbidities, days from hospital to ICU admission, and IL-6 (if available). Note that traditional serum markers of nutrition, such as albumin, pre-albumin, and transferrin, are not used for nutrition assessment in the ICU because of the acute phase response of these values.[6] When patients can meet their nutritional requirements through oral intake, EN

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is not needed. However, if oral nutrition is contraindicated or insufficient, EN support is the first line of nutrition that should be considered in the critically ill patient. In the ICU, there are many situations in which EN is contraindicated, such as hemodynamic instability or an inability to use the GI tract (e.g., obstruction, bleeding, ischemia, perforation, and malabsorption). In these cases, many other factors must be evaluated in considering whether and when to start parenteral nutrition.

INITIATION OF ENTERAL NUTRITION

Generally, EN should be initiated as soon as possible into the course of critical illness through an acceptable route of access. In patients with low nutritional risk, if oral intake cannot be initiated immediately, waiting up to seven days prior to initiation is acceptable. However, in patients at moderate to high nutritional risk, initiation of EN should begin as soon as 24-48 hours after admission to the ICU or after oral intake is deemed unsuitable. Early initiation of enteral feeds has benefits beyond improving nutritional status compared with withholding or delaying EN. These benefits may exist even with minimal volumes, also known as trophic feeds. By maintaining villous height and supporting immunocytes in the gut-associated lymphoid tissue, EN helps maintain the functional integrity of the gut and modulate the systemic stress immune responses.[7] A meta-analysis of 21 randomized, controlled trials showed that early EN was associated with a significant reduction in mortality (relative risk [RR] = 0.70; 95% confidence interval [CI], 0.49-1.00; $P = 0.05$) and infectious morbidity (RR = 0.74; 95% CI, 0.58-0.93; $P = 0.01$) compared with delayed EN.[3]

To initiate EN, a route of access must be established. In most critically ill patients, EN access in the stomach via orogastric (OG) or nasogastric (NG) tube is acceptable. However, small bowel enteral access is indicated in those critically ill patients at high risk for aspiration or with documented intolerance to gastric EN. There is conflicting evidence in the literature, but recent aggregate data show a decrease in risk of pneumonia in small bowel EN but no difference in mortality or length of stay compared with gastric EN.[3] Evidence for adequate bowel function such as passage of flatus/stool or presence of

Table 1: Summary of General Recommendations for Enteral Nutrition in the ICU

- A full assessment of nutritional risk should be performed by a dietitian on all patients admitted to the ICU.
- Initiation of enteral nutrition should begin as soon as 24-48 hours after admission to the ICU, or after oral intake is deemed suitable.
- In general, standard isotonic (or near-isotonic) formulas with 1-1.5 kcal/mL are recommended for initiation.
- Indirect calorimetry is suggested as the best mode of assessment of energy requirements; if unavailable, a simplistic weight-based equation is used to determine energy requirements at 25-30 kcal/kg/day.
- Trophic feeds at a slow rate help prevent mucosal atrophy and maintain gut integrity.
- Gastric residual volumes are not recommended for routine monitoring of enteral nutrition tolerance; rather, physical exam, review of radiographs, and evaluation of clinical risk factors are recommended.

Table 2: Recommendations for Special Populations in the ICU

Shock and sepsis	Enteral nutrition may be provided once patients are on chronic, stable, low doses of vasopressors.
Respiratory failure	In patients requiring invasive mechanical ventilation, fluid-restricted, energy-dense enteral nutrition formulations should be considered to target 50-65% of energy needs.
Obesity	High-protein hypocaloric feeding is recommended to preserve lean body mass, mobilize adipose stores, and minimize the metabolic complications of overfeeding.

bowel sounds are not required prior to initiation of EN. Bowel sounds are indicative of contractility but not mucosal integrity, barrier function, or absorptive capacity. Hypoactive or absent bowel sounds are associated with worsened prognosis and higher mortality.[8]

SELECTION OF ENTERAL NUTRITION

Selection of EN formula and dosage is complex and should be optimized together with a registered dietitian. There are both general guidelines as well as specific recommendations for different ICU populations. In selecting a formula from the myriad available, first, of course, is to know what is available in your hospital. In general, standard formulas, which are isotonic or near isotonic with 1-1.5 kcal/mL, are recommended for initiation of EN in the ICU. Sometimes, fiber is added to EN formulas to promote bowel regularity or treat diarrhea. It is not recommended to use fiber-containing formulas prophylactically in the adult critically ill patient; in fact, fiber-containing formulas should be avoided in patients at high risk for bowel ischemia or severe dysmotility. However, fiber-containing formulas can be considered in the presence of persistent diarrhea. Assessment of the patient's digestive and absorptive capabilities of the patient also can aid with formula selection. If a patient experiences malabsorption or maldigestion, a peptide-based elemental formula can be considered. If the patient is fluid-restricted, such as in a volume-overloaded state or with renal failure, a concentrated 2 kcal/mL formula should be considered. There are many specialty type formulas available, such as immune-modulating formulations made with arginine, eicosapentaenoic acid, docosahexaenoic acid, glutamine, and nucleic acid, or immune-enhancing formulations with anti-inflammatory lipid profiles and antioxidants. Data are not yet strong enough to recommend their routine use in the ICU.

DOSING OF ENTERAL NUTRITION

The dose for EN includes both goal calories and rate of delivery. Indirect calorimetry (IC) is suggested as the best mode for assessing energy requirements, but may not always be available or accurate. IC measures the change in concentration of pulmonary gas to determine the resting metabolic rate, resting energy expenditure, and respiratory quotient. Although it is considered the gold standard measurement for energy expenditure, it is expensive, labor-intensive, and requires repeated measurements. Factors in the critically ill patient such as air leaks, chest tubes, supplemental oxygen, ventilator settings, renal replacement therapy, anesthesia, or excessive movement may affect the accuracy of IC.[9] In the absence of accurate IC, a simplistic weight-based equation is used to determine energy requirements at 25-30 kcal/kg/day. In obese, underweight, and volume-overloaded patients, this also would be inaccurate, and adjustments are made based on body mass index (BMI). Generally, one should aim to provide more than 50-65% of goal calories, with protein of 1.2-2.0 g/kg of actual body weight, per day.[3] In most critically ill patients, continuous infusion EN will lead to less intolerance than bolus gastric EN. Trophic feeds are defined as 10-20 mL/hour, 10-20 kcal/hour, or up to 500 kcal/day. Trophic feeds are intended to prevent mucosal atrophy and maintain gut integrity in low- to moderate-risk patients, but they may be insufficient to achieve the nutritional goals desired for EN therapy in high-risk patients.

MONITORING OF ENTERAL NUTRITION

After initiation of EN, periodic monitoring is important to evaluate for tolerance and adequacy of EN. Signs of intolerance may include vomiting, abdominal distension or discomfort, high NG output, high gastric residual volumes (GRVs), diarrhea, reduced flatus or stool, or abnormal radiographs. Traditionally, GRVs of 200-250 mL were considered threshold levels to temporarily stop EN. GRVs no longer are recommended for routine monitoring of tolerance. If used, EN should be held only if GRV is > 500 mL in the absence of other signs of intolerance. Instead, careful physical exam, review of abdominal radiographs, and evaluation of clinical risk factors for aspiration are recommended for monitoring critically ill patients receiving EN.

SPECIAL POPULATIONS

For the purposes of this review, there is a focus on three special populations that are common in the medical ICU setting.

SHOCK AND SEPSIS

Shock and sepsis are common conditions in the ICU, often requiring aggressive fluid resuscitation and vasopressors. It is recommended that EN be initiated within 24-48 hours of presentation in this population once hemodynamically stable, as early EN is associated with decreased hospital mortality in those on vasopressors.[10] EN should be withheld when vasopressors are initiated or escalated, but may be provided once patients are on "chronic, stable, low" doses of vasopressors.[3] Specifically in septic shock, hemodynamic stability is defined as adequate perfusion pressure, stable doses of vasoactive drugs, stabilized or decreasing levels of lactate and metabolic acidosis, and mean arterial pressure (MAP) ≥ 60 mmHg. Risks of using the GI tract in shock include subclinical ischemia and reperfusion injury involving the intestinal microcirculation, and, very rarely, ischemic bowel. Patients on vasopressors should be monitored

very closely for early signs of gut ischemia. If signs exist, feeding should be held. Trophic feeds, at 10-20 kcal/hour or up to 500 cal/day are recommended for the initial phase of sepsis, and it may be most appropriate and optimal to maintain trophic rates for the first 24-48 hours after initiation of feeds.[11] Special formulations have been considered in shock and sepsis. There was previous excitement that immune-modulating formulas (which may contain glutamine, antioxidants, trace elements, butyrate, and/or arginine) or immune-enhancing formulas (which may contain omega-3 fatty acids, gamma-linolenic acid, and/or antioxidants) may improve outcomes and decrease length of stay (LOS) or organ dysfunction.[12] However, follow-up randomized, controlled trials have failed to show a clear benefit in a medical ICU setting; thus, they currently are not recommended. Selenium and zinc have been studied for their antioxidant properties with some promise, but there are no formal recommendations for their use yet because of conflicting studies.

RESPIRATORY FAILURE

Patients in the ICU may develop respiratory failure requiring invasive or noninvasive ventilation support. First, safety of feeding must be considered; it is difficult to safely deliver EN to patients on noninvasive ventilation. Patients on noninvasive ventilation receiving EN via NG or OG access demonstrate higher rates of mucus plugging, aspiration pneumonia, and airway complications.[13] With invasive mechanical ventilation, gastric access produces the dual benefit of GI decompression and nutritional access. High-fat/low-carbohydrate formulations have been proposed to reduce the duration of mechanical ventilation in patients with respiratory failure compared to standard formulas, but the small trial that showed initial promise was unable to be reproduced in a larger study.[14] To optimize volume status in patients with respiratory failure, fluid-restricted, energy-dense EN formulations with 1.5-2 kcal/mL should be considered. Any patient with acute respiratory distress syndrome who is expected to require mechanical ventilation for at least 72 hours should start EN. Whether mechanically ventilated patients should be prescribed trophic feeds or full feeds is under investigation. In 2012, the EDEN study compared one week of trophic feeds with full EN and showed a lower incidence of GI intolerance in the trophic group, who also did not experience worse outcomes compared with those who received full feeds; these were studies of patients who exhibited lower nutrition risk.[15] In contrast, the INTACT study published in 2015 showed that providing intensive nutrition (> 75% of estimated energy needs) led to higher mortality than standard nutrition; the standard nutrition group received approximately 55% of estimated energy.[16] For now, aiming for 50-65% of energy needs may be an appropriate goal in ARDS as we await further studies.

OBESITY

Obesity is common in the ICU, with a prevalence of up to 75%.[17] Although obese patients would seem to possess an excess nutritional reserve, critically ill obese patients are nonetheless at risk for malnutrition. In fact, 57% of hospitalized adults with a BMI > 25 kg/m^2 show evidence of malnutrition. Obese patients are more likely than lean subjects to demonstrate difficulty using fuel and to lose their lean body mass from protein metabolism. There is a U-shaped mortality curve for BMI, with highest mortality in those with Class III obesity (BMI > 40 kg/m^2) as well as those with a BMI < 25 kg/m^2 (underweight or normal weight). Those with moderate obesity, with a BMI of 30-40 kg/m^2, actually demonstrate the lowest mortality rate. This is called the obesity paradox.[18] Use of high-protein, hypocaloric feeding is recommended to preserve lean body mass, mobilize adipose stores, and minimize the metabolic complications of overfeeding. If IC is used, the EN regimen should target 65-70% of energy requirements for all classes of obesity. If IC is not used, dosing for BMI of 30-50 kg/m^2 should be 11-14 kcal/kg actual body weight, and and for BMI > 50 kg/m^2, dosing should be 22-25 kcal/kg ideal body weight. Protein recommendations are based on ideal body weight and should be provided at about 2.0 g/kg/day for BMI of 30-40 kg/m^2 and 2.5 g/kg/day for BMI > 40 kg/m^2.[19]

SUMMARY

EN support is an important and complex component in the management of critically ill patients. *(See Table 1.)* EN should be considered early in those who cannot maintain their nutritional needs via oral feeding, ideally started within 24 to 48 hours of presentation in the ICU or when hemodynamics stabilize. Providers should consult a nutritionist to assist with nutrition risk stratification and selection and dosing of formula. Clinical conditions, such as shock and sepsis, respiratory failure, malabsorption, malnutrition, and obesity, may alter the nutritional need. *(See Table 2.)* There are more risks associated with overfeeding than underfeeding, and even trophic feeds produce significant benefit. Evidence is constantly evolving regarding best practices in the nutritional management of the critically ill patient, so stay alert for updated guidelines. ■

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ABSTRACT & COMMENTARY

Spontaneous Breathing Trials and Occam's Razor

By Richard Kallet, MS, RRT, FCCM

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Mr. Kallet reports he is a major stockholder in the Asthma & Allergy Prevention Company and receives grant/research support from Nihon-Kohden.

SYNOPSIS: Different ventilator modes used for a spontaneous breathing trial affected a patient's work of breathing (WOB) variously and differed regarding WOB measured after extubation. The clinical relevance of these differences is uncertain.

SOURCE: Sklar MC, Burns K, Rittayamai N, et al. Effort to breathe with various spontaneous breathing trial techniques. *Am J Respir Crit Care Med* 2017;195:1477-1485.

This meta-analysis of 16 prospective clinical studies with 239 adult subjects examined the effect of six approaches to conducting a spontaneous breathing trial (SBT), which included: pressure support (PS) of 5-10 cm H_2O, continuous positive airway pressure (CPAP) of 5-8 cm H_2O, T-piece (T-P), mimicking T-P on the ventilator (i.e., PS = 0/ CPAP = 0 cm H_2O), automatic tube compensation, and neutrally adjusted ventilatory assist. The meta-analysis included studies that were randomized crossover (n = 8), non-randomized crossover (n = 7), and a parallel group randomized, controlled trial. The primary finding was that SBTs performed with either low level PS or CPAP produce a comparable effect on work of breathing (WOB). Moreover, an SBT with PS reduces WOB by 30% compared

to T-P and 46% compared to post-extubation measurements. The authors concluded that performing an SBT using either T-P or its correlate while attached to a ventilator represents "the optimal method for evaluating weaning readiness."

■ COMMENTARY

Sklar et al nobly attempted to determine if the mode used for SBTs produces meaningful differences in WOB that might affect the success of an extubation trial. Unfortunately, their conclusion is highly suspect. A meta-analysis is ill-suited for assessing these studies and drawing meaningful conclusions given the methodological vagaries related to measuring and assessing respiratory muscle function in patients recovering from acute respiratory failure.

The maximal sustainable WOB level in patients recovering from acute respiratory failure has never been established. Years ago, Petros et al successfully extubated patients from CPAP and T-P with WOB levels (1.13 and1.35 J/L, respectively) that previously were considered incompatible with successful weaning (i.e., > 0.75 J/L).[1] Physiologic studies of WOB require a uniform baseline (i.e., measurements made at rest) to be meaningful; humans tend to breathe at 0.3-0.5 J/L. Yet, it's precarious to assume these WOB levels accurately reflect what is encountered during activities of daily living, let alone provide particularly useful information for making clinical decisions.

Moreover, a meta-analysis cannot account for important differences in measurement techniques when an endotracheal tube is present and post-extubation (when a tight-fitting mask or mouth piece is necessary). Even setting aside technological issues related to measuring flow and volume between intubated and non-intubated conditions, it's highly improbable that "breathing behavior" in a conscious subject with an artificial airway is the same as when a clinician is holding a mask over the patient's face tightly or when a patient tries to hold a mouth piece firmly in place. This problem was illustrated nicely by an intriguing contradiction in one of the cited studies. Despite a cross-sectional glottic area almost three times greater than the endotracheal tube (140 mm^2 vs. 50 mm^2), inspiratory effort paradoxically increased by 33%, WOB increased by approximately 150%, and mean tidal volume decreased by 23%. Even in a meticulously executed study, vexing findings can result and likely reflect these inherent methodological limitations.

Loss of interest in measuring WOB coincided with the publication of numerous SBT studies reaffirming the long-held impression that at least 70% of patients successfully resume unassisted breathing by simply withdrawing mechanical support. One study cited in the meta-analysis reported that extending an SBT by one hour to evaluate patients while breathing through a T-P offered no advantage compared to a minimum PS trial (i.e., ~ 7 cm H_2O). Moreover, a large randomized trial found a significantly higher SBT success rate with PS of 7 cm H_2O vs. T-P (86% vs. 78%, respectively) without significant differences in those remaining extubated after 48 hours (70% vs. 63%, respectively).[2] It's important to note that patients often exhibit significant buildup of biofilm and/or a particularly tortuous upper airway anatomy to which the pliable endotracheal tube conforms over time. Using low-level PS provides some offloading for these occult factors and is a matter of clinical expediency. Thus, the authors' conclusion that T-P is the "optimal method" for conducting a SBT should be greeted with skepticism.

Regarding weaning, it's helpful to apply Occam's razor, which can be stated as follows: Patients sufficiently recovered from acute respiratory failure breathe without assistance when their minute ventilation demand decreases to the point that their respiratory muscles can handle the increased workload imposed by residual abnormalities in chest mechanics. ■

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ABSTRACT & COMMENTARY

Angiotensin II Raises Blood Pressure in Patients with Vasodilatory Shock

By Samuel Nadler, MD, PhD

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Dr. Nadler reports no financial relationships relevant to this field of study.

SYNOPSIS: Infusion of recombinant angiotensin II improved blood pressure control in patients with vasodilatory shock already receiving conventional vasopressors.

SOURCE: Khanna A, English SW, Wang XS, et al. Angiotensin II for the treatment of vasodilatory shock. *N Engl J Med* 2017;377:419-430.

Shock is a common and life-threatening condition often seen in the ICU. Sepsis commonly causes vasodilatory shock and continues to produce a significant mortality, despite improvements in care. The treatment of shock includes fluid resuscitation and vasopressor agents such as norepinephrine, epinephrine, or vasopressin. Some patients require multiple vasopressor agents and still are unable to meet resuscitation goals.

The authors of the ATHOS-3 trial examined a new class of vasopressor agent, angiotensin II (ATII), as add-on therapy to conventional vasopressors. This study of 344 patients ≥ 18 years of age randomized patients with confirmed vasodilatory shock despite fluid resuscitation to receive an infusion of ATII or placebo in addition to conventional vasopressor agents. Vasodilatory shock was defined by cardiac index > 2.3 L/min/m^2, central venous O_2 saturation > 70% with central venous pressure > 8 mmHg with a mean arterial pressure (MAP) 55-70 mmHg despite vasopressor therapy. During the first three hours of the study, the conventional vasopressor agents were held constant while ATII or placebo could be titrated with a goal MAP > 75 mmHg. Between three and 48 hours, all vasopressor infusions could be titrated with goal MAP 65-75 mmHg. The primary endpoint was MAP > 75 mmHg or an increase in MAP of > 10 mmHg without an increase in baseline vasopressors.

During the first three hours of the study, more patients in the ATII arm achieved MAP > 75 mmHg than in the placebo arm (69.9% vs. 23.4%; $P < 0.001$). During the 48-hour trial period, patients in the ATII group required less conventional vasopressors than placebo and demonstrated greater improvements in cardiovascular SOFA scores (-1.75 vs. -1.28; $P = 0.01$), although overall SOFA was unchanged at 48 hours. Patients with hypoalbuminemia were more likely not to respond to ATII therapy. Adverse effects leading to discontinuation of study medications occurred in 14.1% of patients receiving ATII and 21.5% of patients on placebo. All-cause mortality at seven and 28 days was not statistically different between the two groups.

■ COMMENTARY

ATII is a novel vasopressor agent that works via the renin-angiotensin-aldosterone system. It increases blood pressure via vasoconstriction mediation by G-coupled proteins as well as the stimulation of both antidiuretic hormone and aldosterone secretion. As in previous trials, the ATHOS-3 trial demonstrated that infusion of recombinant ATII increases blood pressure compared with placebo. However, several features of this study deserve attention. First, during the first three hours of the study, only ATII could be titrated, and other vasopressors were continued at their pre-study doses. Thus, the conclusion that ATII improved MAP does not imply that these goals could not have been achieved with conventional vasopressors alone. Second, the primary endpoint was MAP > 75 mmHg or an increase in MAP by at least 10 mmHg. Current guidelines recommend goal MAP > 65 mmHg, and it is unclear what benefit, if any, would be achieved by increasing the MAP beyond 65 mmHg.[1] In fact, most patients enrolled in the study started with MAP > 65 mmHg (68.1% and 68.4% in the ATII and placebo groups, respectively). Thus, most patients in this trial did not exhibit an indication for additional vasopressors under current guidelines. Ultimately, the goal of shock treatment is to improve organ perfusion and preserve function. MAP is a surrogate but as with phenylephrine, vasopressors may increase MAP yet decrease perfusion. Indeed, there was no change in total SOFA scores between the two groups. Although underpowered to detect a change in mortality, no statistically significant change was observed.

The ATHOS-3 trial represents an important proof of concept trial regarding ATII as a new vasopressor in

the armamentarium to treat vasodilatory shock. Clearly, ATII increases blood pressure in patients. The appropriate indications for ATII still must be established. One might consider the synergistic use of ATII to enable reducing dosing of adrenergic agonists and reduce adverse effects. However, while there were fewer episodes of supraventricular tachycardia in the ATII arm, there were more episodes of ventricular tachycardia and tachycardia overall. The notion of synergism of vasopressin with adrenergic agents is increasingly coming under question. Future well-powered and well-designed trials of ATII are required before further adoption of this agent for the treatment of vasodilatory shock. ■

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CME/CE QUESTIONS

1. Which of the following statements is *true* regarding enteral nutrition goals in the ICU?
a. Enteral nutrition should start within 24-48 hours of admission to an ICU for all patients who are unable to tolerate a full oral diet regardless of nutrition risk.
b. Calorie goals are calculated as 25-30 kcal/kg/day of ideal body weight.
c. One should aim to provide 75-100% of goal calories through enteral nutrition.
d. Fiber should be added routinely to enteral formulas in the ICU to decrease the risk of diarrhea.
e. Concentrated 2 kcal/mL formulas should be considered to decrease volume of feeds in patients who are fluid restricted.

2. Which of the following statements is *false* regarding obese patients in the ICU?
a. For body mass index (BMI) of 30-50 kg/m^2, actual body weight should be used to calculate energy requirements.
b. The obesity paradox describes the lower mortality in those with a BMI of 30-40 kg/m^2 compared to those who are of normal weight or underweight.
c. High-protein, hypocaloric feeding is recommended to target ≥ 75% of energy requirements for all classes of obesity.
d. Protein should be provided at 2.0 g/kg/day of ideal body weight for patients with a BMI of 30-40 kg/m^2.
e. For those with a BMI > 50 kg/m^2, ideal body weight should be used to calculate recommended calories and protein.

3. Which of the following is *not* a method for conducting a spontaneous breathing trial?
a. Low-level pressure support (PS 5-10 cm H_2O)
b. Low-level continuous positive airway pressure (CPAP 5-8 cm H_2O)
c. T-piece
d. Low-level pressure control ventilation

4. Which of the following statements is *true* regarding weaning?
a. T-piece greatly offloads patient work of breathing compared to pressure support.
b. T-piece greatly offloads patient work of breathing compared to a natural airway.
c. Both continuous positive airway pressure and pressure support reduce patient work of breathing to a similar degree.
d. Extending a spontaneous breathing trial by an hour with T-piece reduces extubation failure rates by 25%.

5. In the ATHOS-3 trial:
a. administration of angiotensin II reduced mortality in patients with sepsis.
b. administration of angiotensin II increased mortality in patients with sepsis.
c. angiotensin II failed to increase mean arterial pressure to goal.
d. angiotensin II enabled more patients to achieve goal mean arterial pressure > 75 mmHg.

CME/CE OBJECTIVES

Upon completion of this educational activity, participants should be able to:

- identify relevant topics in the practice of critical care medicine;
- utilize recommendations from current clinical guidelines; and
- manage common critically ill patient and ICU administration scenarios.