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Practical Application of the Revised Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: A Case Study Approach

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Abstract

Background: Nutrition therapy is an essential component of the care plan for critically ill and injured patients. There is consensus that critically ill patients are at risk for malnutrition, and the associated consequences of increased infectious morbidity, multiorgan dysfunction, prolonged hospitalization, and disproportionate mortality can be minimized with specialized enteral and/or parenteral nutrition therapy. *Methods:* In this article, we describe 2 case studies that are intended to introduce the nutrition support clinician to key updates in the recently released Guidelines for Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *Results:* The case studies demonstrate a pragmatic approach to nutrition therapy in the intensive care unit (ICU) and are intended to elicit dialogue for timely, appropriate nutrition care at policy meetings, professional conferences, and ICU daily rounds. *Conclusions:* While explicitly stated in the formal document, it is worth repeating that the guidelines are directed toward generalized patient populations, but as with any therapeutic intervention in the ICU, nutrition therapy should be tailored to the individual patient. In addition, protocols and procedures should reflect the local institutional culture and meet with approval of critical care clinicians. (*Nutr Clin Pract*. 2016;31:334-341)

Keywords

nutritional support; enteral nutrition; parenteral nutrition; critical care; critical illness; intensive care units; practice guidelines

In January 2016, the *Journal of Parenteral and Enteral Nutrition* published the newly revised "Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)" online.[1] The previous edition of the guidelines from these organizations was published in 2009. These documents represent a 4-year process of extensive review and analysis of studies of nutrition therapies published through December 2013, as well as review of other international guidelines for similar patient populations. Recommendations based on evidence or expert opinion of relevant topics (when adequate data were not available) are described with accompanying rationales that cite 473 references of the more than 800 studies reviewed by the Guidelines Task Force. The guidelines offer basic recommendations that are meant to provide clinically useful therapeutic strategies but are challenged by their length and the limitations of the evidence itself. In this article, the authors depict 2 patient situations adapted from their experiences in caring for critically ill patients who required specialized nutrition therapies. Like many real experiences, the following case studies are not "textbook" examples and instead demonstrate how the healthcare teams are often forced to rely on a combination of their own bedside skills, clinical judgment, and knowledge of the literature and guidelines in striving to provide optimal care. In describing the clinical dilemmas that the healthcare teams might encounter, it is the authors' intent to aid practitioners by illustrating how the guidelines may be used to develop treatment plans in real-world settings. Throughout each case study, the authors provide guideline application using only the summary recommendations as they appear in the newly published guidelines. Please refer to the complete document for additional rationale and review of the literature as it applies to each guideline.

Case Study 1. Medical ICU Patient With Severe Acute Pancreatitis

A 49-year-old man presented to the emergency department (ED) with severe abdominal pain, anorexia, and vomiting. His history included poorly controlled type II diabetes mellitus, obesity, and

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hypertriglyceridemia (baseline triglycerides 1000–2000 mg/dL). He had no history of pancreatitis, and his social history was negative for alcohol. His medications included fenofibrate 80 mg, glipizide 5 mg/d, and glargine insulin 60 units each evening. His diet history was significant for 2 days of inability to tolerate solid food, with vomiting and minimal fluid intake. His height was 68 inches, weight 250 pounds (113 kg), and body mass index (BMI) 38 kg/m^2. He had gained 5 pounds in the previous month.

On presentation to the ED, the patient's laboratory values were as follows: blood glucose, 425 mg/dL; triglycerides, 4420 mg/dL; lipase, 11,200 U/L; and lactate, 2.7 mmol/L. An abdominal computed tomography (CT) scan showed marked peripancreatic fat stranding and fluid; mild enhancement of the head of the pancreas raised the possibility of necrotizing pancreatitis with moderate wall thickening involving the duodenum, suggestive of reactive changes due to surrounding inflammation. He was admitted to the General Medicine ward from the ED with intravenous (IV) fluids and an insulin infusion. On the ward, he became somnolent with respiratory depression, sinus tachycardia, and marginal blood pressure of 90/50 mm Hg. His laboratory values were significant for increased lactate to 8.6 mmol/L and creatinine to 2.6 mg/dL. The rapid response team was called, and he was transferred to the intensive care unit (ICU) for aggressive fluid resuscitation and monitoring. During nasogastric (NG) tube placement, he had a cardiopulmonary arrest. He was intubated, received cardiopulmonary resuscitation (CPR), and had return of spontaneous circulation. He required multiple vasoactive agents (ie, norepinephrine, vasopressin, and milrinone) to maintain mean arterial pressure (MAP) above 65 mm Hg, as well as ongoing fluid resuscitation. Medications administered were dexmedetomidine, fentanyl, and meropenem. After the General Surgery service ruled out the need for surgical intervention, a nasoenteric (NE) feeding tube was placed and tip was confirmed to be in the stomach. A standard 1.0-calorie/mL, non-fiber-containing enteral formula was initiated at 20 mL/h on ICU day 2 when his lactate had normalized and vasopressor agents (pressors) were being weaned. It was anticipated that he might not tolerate enteral feeding due to inflammatory changes surrounding the duodenum, so signs of intolerance, excluding gastric residual volumes (GRVs), were monitored carefully by the nurse. Although difficult to change local practice, the nurse was following the newly updated ICU enteral feeding protocol for medical ICU patients that eliminated the routine monitoring of GRVs. He had no signs of intolerance, such as abdominal distention and pain, nausea, vomiting, or reduced passage of flatus or stool. He remained hemodynamically stable, and pressors were weaned by the end of the day. Initially, he tolerated enteral nutrition (EN) at 20 mL/h without problems. On ICU day 3, the tube feeding was titrated toward the goal rate of 50 mL/h, but due to worsening abdominal distention, pain, and 2 episodes of vomiting, the tube feeding was stopped during the night. The NG tube was placed to gravity and returned 800 mL residual volume. The gastric NE feeding tube was removed and another NE feeding tube was placed by the nurse with tip in the distal duodenum, and the standard enteral formula was resumed and advanced to goal rate over the subsequent 24 hours. On ICU day 5, he was tolerating goal tube feedings well. To increase the protein provision to 2 g protein/kg, 2 packets of a liquid modular protein product were administered 3 times daily through the NE feeding tube. A mixed-strain probiotic supplement was also dosed twice daily to complete the nutrition regimen. The NG tube for decompression was removed. He continued to tolerate his EN regimen and was transferred out of the ICU on day 7.

Nutrition Care Plan With Guideline Application

Nutrition assessment, timing, and route of nutrition therapy. In the case of acute pancreatitis the nutrition assessment warranted evaluation of disease severity to guide the nutrition care plan. Due to evidence for systemic inflammatory response and organ failure (ie, elevated creatinine, respiratory failure), disease severity was determined to be severe acute pancreatitis. Therefore, EN therapy was considered early in the course. To avoid delay in feeding, the NE tube was placed at the bedside with the tip in the stomach soon after ICU admission. Once the patient was resuscitated and vasopressors were weaning, feeding was initiated at 20 mL/h. Since completion of the revised guidelines, the "Early Versus On-Demand Nasoenteric Tube Feeding in Acute Pancreatitis," known as the PYTHON trial, was published.[2] The multicenter, randomized, controlled study did not support improved clinical outcomes with early enteral feeding as previous studies have that are cited by the revised guidelines. However, in this case example, it was predicted that the patient may require prolonged mechanical ventilation with nil per os (NPO) status and was at high risk for malnutrition. For this reason, EN was attempted early. In addition, the patient was deemed hemodynamically stable due to decreasing pressor doses and MAPs >65 mm Hg. Whether to enterally feed critically ill patients early while on vasopressor agents remains one of the leading questions for clinical providers in the ICU. Pressor doses and clinical symptoms for potential intolerance to EN were monitored carefully after EN initiation. In the author's institution, it is supported that critically ill patients can be fed successfully with caution and appropriate monitoring. In a large retrospective study, Khalid et al[3] compared clinical outcomes for early vs delayed EN in over 1000 patients who required vasopressor agents. The investigators concluded that early EN was associated with a reduction in mortality and found no evidence of harm due to early EN for critically ill patients requiring vasopressor agents. This case emphasized the importance of clinical judgment and individualized recommendations for the critically ill patient.

Guideline application

Guideline L1a. Based on expert consensus, we suggest the initial nutrition assessment in acute pancreatitis evaluate disease severity to direct nutrition therapy. Because disease severity may change quickly, we suggest frequent reassessment of feeding tolerance and need for specialized nutrition therapy.[4]

Guideline L1c. We suggest that patients with moderate to severe acute pancreatitis should have a naso/oroenteric tube placed and EN started at a trophic rate and advanced to goal as fluid volume resuscitation is completed.[5–7]

Guideline L3b. We suggest that EN be provided to the patient with severe acute pancreatitis by either the gastric or jejunal route, as there is no difference in tolerance and clinical outcomes between these 2 levels of infusion.[8–10]

Guideline B5. Based on expert consensus, we suggest that in the setting of hemodynamic compromise or instability, EN should be withheld until the patient is fully resuscitated and/or stable. Initiation/reinitiation of EN may be considered with caution in patients undergoing withdrawal of vasopressor support.[3,11,12]

Formula selection and determining macronutrient requirements. The patient's estimated energy and protein needs were determined by a weight-based equation for the critically ill obese patient in absence of indirect calorimetry (IC). He was prescribed approximately 1600 calories/d or 14 kcal/kg using his actual body weight. His estimated protein needs were 140 g or 2 g/kg using his ideal body weight (IBW). Although the guidelines suggest the use of a low-calorie, high-protein formula in the obese patient, this type of formula was not available on the formulary, and thus a standard, nonfiber formula was selected. A protein modular supplement was used to increase the protein provision to meet the patient's estimated needs.

Guideline application

Guideline L2. We suggest using a standard polymeric formula to initiate EN in a patient with severe acute pancreatitis. Although promising, at this time, the data are currently insufficient to recommend placing a patient with severe acute pancreatitis on an immune-enhancing formulation.[13,14]

Guideline Q5. Based on expert consensus, we suggest for all classes of obesity that the goal of the EN regimen should not exceed 65%–70% of target energy requirements as measured by IC. If IC is unavailable, we suggest using the weight-based equation 11–14 kcal/kg actual body weight/d for patients with BMI in the range of 30–50 kg/m^2 and 22–25 kcal/kg ideal body weight/d for patients with BMI >50 kg/m^2. We suggest that protein should be provided in a range from 2.0 g/kg ideal body weight/d for patients with BMI 30–40 kg/m^2 up to 2.5 g/kg ideal body weight/d for patients with BMI ≥40 kg/m^2.[15–17]

Guideline Q6. Based on expert consensus, we suggest that if available, an enteral formula with low caloric density and a reduced nonprotein calorie to nitrogen ratio be used in the obese adult patient. While an exaggerated immune response in obese patients indicates potential benefit from immune-modulating formulas, lack of outcomes data precludes a recommendation at this time.[18]

Monitoring tolerance of EN therapy. It was suspected that the patient may not tolerate enteral feeding due to previous radiographic evidence for reactive inflammation involving the duodenum and history of intolerance to oral intake prior to admission. The critical care team followed the updated ICU enteral feeding protocol and monitored the patient closely for signs of intolerance without the use of routine GRVs. Consequently, on ICU day 3, tube-feeding titration failed as evidenced by abdominal distention, abdominal pain, vomiting, and high residual obtained from the NG tube (800 mL). The NG tube remained to gravity drainage and a new NE feeding tube was placed to the distal duodenum in hopes of improving tolerance to enteral feeding.

Guideline application

Guideline D2a. We suggest that GRVs not be used as part of routine care to monitor ICU patients receiving EN.[19,20]

Guideline D2b. For those ICUs where GRVs are still used, we suggest that holding EN for GRVs <500 mL in the absence of other signs of intolerance should be avoided.[21,22]

Guideline L4. Based on expert consensus, we suggest that in patients with moderate to severe acute pancreatitis who have intolerance to EN, measures should be taken to improve tolerance.[23–25]

Adjunctive therapies: probiotics in acute pancreatitis. Multistrain probiotic kefir slurry containing *Lactobacillus casei, Lactobacillus rhamnosus*, and *Lactobacillus plantarum* was administered via the feeding tube twice daily beginning on ICU day 5. The estimated probiotic dose was approximately 50^9 colony-forming units (CFU) per day. By ICU day 5, the patient's organ failure was improving, and he demonstrated tolerance to EN so probiotic supplementation was considered safe. The patient showed no adverse effects of probiotic administration. The safety of probiotic use in patients with severe acute pancreatitis has been questioned since the large Dutch PROPATIA trial showed increased mortality with the administration of probiotics.[26] The evidence to date has not duplicated these negative results to completely eliminate probiotic protocols from consideration. A recent meta-analysis by Zhang et al[27] showed a reduction in infectious complications and length of stay but no effect on mortality. Due to heterogeneity, small size, and methodological flaws, large randomized controlled trials are needed for definitive recommendations regarding the use of probiotics in acute pancreatitis. Therefore, the guidelines suggest that use of probiotics be considered, and we have provided an example of potential use for a probiotic protocol.

Guideline application

Guideline L5. We suggest that use of probiotics be considered in patients with severe acute pancreatitis who are receiving early EN.[7,27]

Case Study 2. Surgical ICU Patient With an Open Abdomen

A 77-year-old woman presented to the ED via ambulance after a 2-day history of burning with urination and sharp lower abdominal pain that had progressively worsened. She had a medical history of cervical cancer treated with radiation therapy 20 years prior. Since that time, she had experienced multiple urinary tract infections. On this occasion, she had attempted to relieve her dysuria with pyridium without noticeable improvement. Her medical history was also significant for hypothyroidism, hyperlipidemia, and iron deficiency. She had no surgical history. Daily home medications included simvastatin 10 mg, levothyroxine 100 mcg, iron 325 mg, and weekly vitamin D2 50,000 international units for osteopenia. She denied tobacco use and drank alcohol less than once a month.

Her height was 66 inches, weight 52 kg, and body mass index 18.5 kg/m^2, and she denied trouble eating but described a decreased appetite for 1 week prior to admission. She also reported allergies to sulfa. Physical examination was remarkable for abdominal tenderness over the pubis and labia majora extending into the perineum with induration and edema of the vulva. Baseline vital signs were as follows: temperature, 36.8°C; sinus tachycardia with rate 122; blood pressure, 110/50 mm Hg; respiratory rate, 20; and oxygen saturation, 97%–99%. There was no flank tenderness, drainage, or edema. Initial laboratory values were as follows: white blood cells (WBCs), 24.2 × 10^3/μL; hemoglobin, 7.9 g/dL; hematocrit, 25.5%; platelets, 715/μL; neutrophils, 91.8%; lipase, 13 U/L; lactate, 3.5 mmol/L; blood glucose, 92 mg/dL; sodium, 132 mEq/L; potassium, 5.1 mEq/L; chloride, 103 mmol/L, CO_2, 19 mmol/L; serum urea nitrogen, 81 mg/dL; creatinine, 1.5 mg/dL; glomerular filtration rate, 34; serum albumin, 2.2 g/dL; alanine aminotransferase, 23 IU/L; aspartate aminotransferase, 34 IU/L; alkaline phosphatase, 225 IU/L; and total bilirubin, 0.7 mg/dL. Urinalysis revealed hazy orange color, specific gravity 1.015, and WBCs >182 × 10^3 μL and was positive for bacteria in clumps.

At presentation she had 2 of 4 systemic inflammatory response syndrome (SIRS) criteria with tachycardia and leukocytosis possibly related to urosepsis or soft tissue infection of the vulva. She was admitted initially to a medical-surgical unit and had ceftriaxone IV 1 g/d ordered along with fluid resuscitation, blood and urine cultures, and a Foley catheter. On admission, there was evidence of acute kidney injury with a creatinine of 1.5 mg/dL (baseline of 1.0 mg/dL); she was also prerenal with azotemia and mild hyperkalemia in the setting of severe sepsis.

Further diagnostic studies over the next 24 hours, including ultrasound and CT scan of the pelvis, led to the diagnosis of necrotizing soft tissue infection requiring surgical intervention. She was emergently taken to the operating room (OR) for necrotizing fasciitis of the anterior abdominal wall in the subcutaneous fat and rectus abdominis musculature extending into the labia. She underwent wound debridement of the perineum, labia, and lower abdominal wall and was transferred to the ICU with an open abdomen and was on mechanical ventilation, receiving propofol, fentanyl, and norepinephrine to keep MAP >60 mm Hg with an elevated lactate. She was NPO with an NG tube in place and was treated with vancomycin and metronidazole for a positive urine culture.

She was assessed to be at high nutrition risk due to her low BMI, current NPO status, septic shock with hemodynamic instability, open abdomen with the surgical team planning frequent debridement and washout procedures in the OR, and projected lengthy hospitalization. The decision was made to initiate parenteral nutrition (PN) while she remained on trophic EN due to her requirement of vasopressor agents (pressors) for hemodynamic instability. IC had not yet been performed so a weight-based predictive equation was used to estimate initial needs. With a weight of 52 kg and extensive surgical wounds, initial estimated nutrition goals were 25–30 kcal/kg/d and 1.5 g protein/kg. An immune-modulating enteral formula was started at 10 mL/h via her NG tube and day 1 PN was administered at 41.6 mL/h using a commercially premixed formulation containing 5% amino acids in 20% dextrose with electrolytes, which provided the following: 50 g protein and 200 g dextrose for a total of 880 kcal over 24 hours. Lipids were not administered. Electrolytes included a standard mix, and multivitamins and trace elements were included. The glucose infusion rate was 2.265 mg/kg/min with a goal of <5 mg/kg/min. About 10 hours after tube feedings began, the bedside nurse reported that small amounts of "tube feeding–like" fluid was suctioned out of her mouth and tube feedings were stopped. On ICU day 2, bedside efforts were unsuccessful at placing a small bowel feeding tube and so that day her PN was slightly modified with a change to a 5% amino acid and 15% dextrose mixture at 65 mL/h, which provided 78 g protein, 234 g dextrose, no lipids yet, but electrolytes, multivitamins, and trace elements continued. She received 1108 kcal/d with this formulation. This provided approximately 85% of estimated needs during the first week in the ICU. The nutritionist's note stated that when lipids (Intralipid 20% 100 mL) could be added on day 7, a total of 1307 kcal/d would be delivered, which was her calorie goal. On ICU day 3, she was treated with prokinetic agents and EN restarted, but she developed abdominal distention, so feedings were again stopped. She was weaned off pressors by that point and hemodynamic parameters were stable, so IC was performed according to standard protocol while she was still intubated. Results were as follows: oxygen consumption, 213 mL/min; carbon dioxide production, 192 mL/min; respiratory quotient, 0.91; and measured resting energy expenditure, 1515 kcal/d. She was moderately sedated and the test reached steady state in 22 minutes. The results were used to adjust the nutrition care plan. Her specific nutrient needs required a custom PN formulation due to her high protein requirements for wound healing and continuous adjustment for electrolytes that was used until she tolerated approximately 70% of her goals from EN. On ICU day 4, small bowel access was established by surgeons when she was in the OR for a washout procedure, and then trophic feedings were restarted and advanced to goal rate over the course of 48 hours using a 1.5-kcal/mL high-protein formula that she tolerated well. By using the small bowel route of

delivery for nutrition therapy, PN was stopped by ICU day 9, and tube feedings were only held for short perioperative periods. IC was repeated every 4 days while she remained intubated, and results were used to adjust nutrition therapy throughout her critical illness. Tube feedings continued to be used to supplement poor oral intake as she improved but underwent more operative debridement and washout procedures. She experienced numerous medical complications over the course of her lengthy hospitalization but was discharged to a skilled nursing facility and eventually returned home.

Nutrition Care Plan With Guideline Application

Nutrition assessment, timing, and route of nutrition therapy. This older patient was at high nutrition risk due to her initial severity of illness and predicted NPO status as a result of multiple extensive surgical debridements and numerous follow-up procedures that would be required in the OR. In addition, she had a low BMI on presentation and a loss of appetite, and a lengthy hospitalization was planned. Although early EN was attempted, due to her nutrition risk and early hemodynamic instability, she was a good candidate for early PN with a commercial formula to start. Later she required a custom compounded PN formulation to meet her high nitrogen needs and frequently changing fluid and electrolyte needs. The ICU nutrition support team reviewed all PN orders and monitored appropriate use daily, in keeping with our PN protocol. Of note: when initiating early PN for a patient at relatively high nutrition risk (NUTrition Risk in the Critically ill (NUTRIC) score = 5–6 without interleukin-6 [IL-6]), care should be taken to reduce inherent risk from hyperglycemia, electrolyte imbalances, immune suppression, increased oxidative stress, and potential infectious morbidity. It is likely that other nutrition support experts would not have resorted to PN in this case,[28–30] yet this older patient at relatively high nutrition risk had a lengthy and unpredictable course of critical illness that responded well to a consistent source of nutrition therapy beginning within 48 hours of admission, which is congruent with the findings in the Doig et al[31] CALORIES trial. This randomized controlled trial involving 1372 patients found that early exclusive PN in patients with relative contraindications to early EN resulted in significantly fewer days of mechanical ventilation, with no difference in 60-day mortality and no significant impact on length of ICU or hospital stay.[31]

Guideline application

Guideline G2. Based on expert consensus, in the patient determined to be at high nutrition risk (eg, a Nutrition Risk Screening [NRS] 2002 score ≥5 or NUTRIC score ≥6, >5 if no IL-6 value) or severely malnourished, when EN is not feasible, we suggest initiating exclusive PN as soon as possible following ICU admission.[32–35]

Guideline H1. Based on expert consensus, we suggest the use of protocols and nutrition support teams to help incorporate strategies to maximize efficacy and reduce associated risk of PN.[36–39]

Guideline H4. Based on expert consensus, use of standardized commercially available PN vs compounded PN admixtures in the ICU patient has no advantage in terms of clinical outcomes.[40]

Determining dose and macronutrient requirements. This patient received approximately 73%–85% of calorie goal (1108 kcal vs 1515 kcal using IC and 1108 kcal vs 1307 kcal using predicted equation, respectively) during the first week of PN therapy. At 96–129 mg/dL, her blood glucose remained well below recommended goals of 140–180 mg/dL. She required extensive fluid resuscitation and vasopressor support for septic shock to maintain adequate blood pressure early in her course. Propofol was used during the initial surgical procedure but was not used for ICU sedation due to concern regarding the drug's soy-based lipid content and potential effects on the inflammatory cascade. Pain and sedation were managed with dexmedetomidine and fentanyl. No soy-based intravenous fat emulsion (IVFE) was provided in the first week of her ICU stay.

Guideline application

Guideline H2. We suggest that hypocaloric PN dosing (≤20 kcal/kg/d or 80% of estimated energy needs) with adequate protein be considered in appropriate (high-risk or severely malnourished) patients requiring PN, initially over the first week of hospitalization in the ICU.[41,42]

Guideline H3a. We suggest withholding or limiting soy-based IVFE during the first week following initiation of PN in the critically ill patient to a maximum of 100 g/wk if there is a concern for essential fatty acid deficiency.[43]

Guideline H3b. Alternative IVFE may provide outcome benefit over soy-based IVFE, but we cannot make a recommendation at this time due to lack of availability of these products in the United States. When these alternative IVFEs (medium-chain triglycerides, olive oil, fish oil, or a combination solution containing soybean oil, medium-chain triglycerides, olive oil, and fish oil) become available in the United States, based on expert opinion, we suggest their use be considered in the critically ill patient who is an appropriate candidate for PN.[44,45]

Guideline H5. We recommend a target blood glucose range of 140–150 to 180 mg/dL for the general ICU population; ranges for specific patient populations may differ (after cardiovascular surgery, head trauma) and are not covered in these guidelines.[46–48]

Monitoring tolerance of nutrition therapy. Efforts were made to initiate EN within 24 hours of her ICU admission while she was also started on PN therapy. Due to gastric feeding intolerance and delayed tolerance of small bowel feeding, as well as the recurring periods of NPO status, PN almost exclusively met her

early nutrition needs. Enteral formula considerations focused on her need for high protein for high exudate drainage, tissue repair, and wound healing. On ICU day 3, she was treated with prokinetic agents to facilitate tolerance when EN was restarted. A peptide-based, high-nitrogen, immune-modulating formula for metabolic stress was chosen as the initial enteral formulation. Her renal function had not completely returned to normal (creatinine 1.3 mg/dL), but no adjustments were made to the calorie or protein recommendations in her nutrition regimen, and her renal function was not adversely affected. As soon as it was determined that she was tolerating EN at approximately 70% of her goal rate, PN therapy was discontinued.

Guideline application

Guideline D4c. We suggest that in patients at high risk of aspiration, agents to promote motility such as prokinetic medications (metoclopramide or erythromycin) be initiated where clinically feasible.[49]

Guideline H7. Based on expert consensus, we suggest that, as tolerance to EN improves, the amount of PN energy should be reduced and finally discontinued when the patient is receiving >60% of target energy requirements from EN.[50]

Guideline J1. Based on expert consensus, we suggest that ICU patients with acute kidney injury should be placed on standard enteral formulation, and standard ICU recommendations for protein (1.2–2.0 g/kg actual body weight/d) and energy (25–30 kcal/kg/d) provision should be followed. If significant electrolyte abnormalities develop, a specialty formulation designed for renal failure (with appropriate electrolyte profile) may be considered.[51,52]

Guideline M3a. Based on expert consensus, we suggest early EN (24–48 hours postinjury) in patients treated with an open abdomen in the absence of bowel injury.[53,54]

Guideline M3b. Based on expert consensus, we suggest providing an additional 15–30 g protein/L of exudate lost for patients with open abdomen (with energy provision similar to other patients in a surgical ICU setting). Energy needs should be determined as for other ICU patients.[55–57] The rationale for this recommendation reminds us that in more complex situations, nutrition management must be individualized to allow for optimal care of the patient. EN is clearly not feasible postoperatively if there is evidence for continued obstruction of the gastrointestinal tract, bowel discontinuity, increased risk for bowel ischemia, or ongoing peritonitis. EN may be feasible postoperatively in the presence of high-output fistulas, severe malabsorption, shock, or severe sepsis if the patient remains stable for at least 24–36 hours.

Appropriate transitions for nutrition therapy. The patient returned to the OR on numerous occasions for debridement and washout procedures; she also experienced complications of an extension of the necrotizing fasciitis to the rectum requiring colostomy, and she sustained a bladder injury necessitating a cystectomy with an ileostomy. PN therapy continued while these issues were managed over the course of the first 7–10 days. She was not in septic shock long, but she was not immediately "out of the woods" either since she was at high risk for late infectious complications. The ICU team's goal was to ensure her nutrition status was optimized, so EN with an immune-modulating formula was chosen. She continued to receive high-nitrogen immune-modulating EN until she was no longer returning to the OR on a regular basis and was tolerating an oral diet well.

Guideline application

Guideline O1. Based on expert consensus, we suggest determination of nutrition risk (ie, NRS 2002 or NUTRIC score) be performed on all postoperative patients in the ICU and that traditional visceral protein levels (serum albumin, prealbumin, and transferrin concentrations) should not be used as markers of nutrition status.[35,58–60]

Guideline O2. We suggest that EN be provided, when feasible, in the postoperative period within 24 hours of surgery, as it results in better outcomes than use of PN or standard therapy (IV fluids, no EN or PN, advancement to oral diet as tolerated).[61,62]

Guideline O3. We suggest the routine use of an immune-modulating formula (containing both arginine and fish oils) in the surgical ICU for the postoperative patient who requires EN therapy.[63–66] This recommendation is also addressed in E2. We suggest immune-modulating enteral formulations (arginine with other agents, including eicosapentaenoic acid, docosahexaenoic acid, glutamine, and nucleic acid) should not be used routinely in the medical ICU. Consideration for these formulations should be reserved for patients with traumatic brain injury and perioperative patients in the surgical ICU.[67,68]

Guideline O4. We suggest enteral feeding for many patients in difficult postoperative situations such as prolonged ileus, intestinal anastomosis, open abdomen, and need of vasopressors for hemodynamic support. Each case should be individualized based on perceived safety and clinical judgment.[3,69]

Summary

This case study approach to a practical implementation of the revised "Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient"[1] for the bedside practitioner highlights new and updated recommendations but also includes recommendations that did not change, in part due to a lack of any new evidence on the topic. This approach also demonstrates that there continue to be areas of controversy and perhaps differences in institutionally driven practices. It is possible that some institutions and nutrition support experts may have handled these case examples differently. For example, in the first case study, it is reasonable that enteral feeding protocols may encourage a trial of promotility agents

prior to changing the feeding route when there is intolerance to EN. Due to the likelihood of a functional obstruction related to inflammation surrounding the duodenum, it was determined that resorting to a distal feeding tube instead of a trial of promotility agents was the best course of action. As mentioned earlier, other nutrition support experts may have delayed PN in favor of more aggressive EN in case study 2,[28–30] but knowing their institutional barriers, it was the surgical teams' preference and goal to ensure a consistent source of nutrition for the high-risk patient throughout her ICU course. We cannot say unequivocally which nutrition intervention, the early PN or the addition of immune-modulating EN, was most responsible for her healing, absence of infectious complications, or even survival. We can say that most likely the evidence-based recommendations and meticulous vigilance by members of the nutrition support team, and the ICU team, very likely contributed to her favorable metabolic and surgical outcomes. For further reading related to controversies and comparisons between findings of recently published nutrition trials and those published by the end date for inclusion (December 2013) in the revised guidelines,[1] please read the companion article in the April issue of *Nutrition in Clinical Practice*.[70]

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Statement of Authorship

M. Warren, M. S. McCarthy, and P. R. Roberts equally contributed to the conception and design of the case studies; M. Warren and M. S. McCarthy contributed to the acquisition of realistic clinical data and description of the patient scenarios; and M. Warren, M. S. McCarthy, and P. R. Roberts equally contributed to the editing and final summary of the data. All authors drafted the manuscript, critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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