Nutrition and GI

**How much?**

The goal of nutritional supplementation is to meet but not exceed the nutritional requirements of patients with critical illness. Due to the inherent variability between patients and disease states, any formula is at best an educated guess. However, more complicated formulas do not usually provide much better guesses than a simplified standardized approach.

**Calories**

The standard recommendation for critically ill patients is 25-30 kcal/kg/day; early during the course of severe illness some experts recommend 20-25 kcal/kg/day.

**Protein**

Protein recommendations are 1.2-2 g/kg/day.

**Special populations**

**Bariatric**

For bariatric patients, hypocaloric feeding is recommended, 11-14 kcal/kg/day. However, when using their ideal body weight, this equates to a recommendation of 22-25 kcal/kg/day. Protein requirements for patients with a BMI of 30-40 are >2 g/kg/day, and for those with a BMI of >40 the goal is 2.5 g/kg/day.

**Renal failure**

Neither kilocalories or protein requirements should be adjusted for critically ill patients with acute or chronic renal failure. Adequate protein should be provided to meet the needs of critical illness, with renal replacement therapy used as required. Lower protein formulas as a strategy to avoid renal replacement therapy should be avoided.

**Hepatic failure**

The majority of patients with chronic liver disease are malnourished, and baseline recommendations suggest that 40 kcal/kg day and protein 1.5-2 g/kg/day is necessary in the outpatient setting to replete protein, muscle, and fat stores. However, in the setting of critical illness, standard caloric and protein goals should be used. One of the most controversial areas is the use of branched chain amino acids. These supplements may have a benefit in patients with chronic encephalopathy who are unable to tolerate standard enteral nutrition, and a potential use in patients with acute liver failure whose encephalopathy worsens with standard enteral nutrition. There is little to no evidence of benefit when provided as standard supplemental nutrition to patients with acute liver failure.

**Burns**
Several additional formulas are available to help calculate nutritional requirements for burn patients; underlying all is some attempt to increase calories and protein in relation to percent total body surface area burned. One of these is the Curreri formula: for adults 16-69, caloric requirement is 25 kcal/kg/day + 40 kcal/% TBSA burned/day. Another recommendation is the use of the Harris-Benedict equation, using a stress factor of 1.2-1.5 for all but the most severe burns, in which case the stress factor may need to be increased to 2. Unfortunately, the majority of these are older formulas and probably overestimate caloric needs. Indirect calorimetry is recommended as the method of monitoring nutritional status in burn patients to avoid over- or underfeeding. Enteral nutrition with glutamine supplementation is recommended for all critically ill burn patients.

Monitoring

Serum albumin can be used in the well patient to help screen for malnutrition or nutritional risk, along with other historical factors and findings on the physical exam. However, in critically ill patients the transcapillary escape of albumin into the interstitial space is markedly increased, and therefore albumin more accurately reflects severity of disease rather than nutritional status. Similarly, prealbumin varies with C-reactive protein, a marker of inflammation; rising prealbumin may reflect improved nutritional status but may also reflect a decreasing inflammatory response without an improvement in nutritional status. A positive nitrogen balance best determines adequacy of nutritional supplementation; this can be measured in a variety of ways, including measurement of 24-hour urea nitrogen excretion. Indirect calorimetry is the gold standard for monitoring adequacy of nutrition, although it requires specialized equipment and can be both cumbersome and expensive.

Nutrition support teams

Although it may be obvious, the presence of a team member specifically addressing the nutritional needs of the critically ill improves outcomes. Patients receive a higher percentage of their target or prescribed nutrition when a nutrition support protocol is initiated, and there is additional benefit for a specific nutrition support team. These teams may make practitioners more aware of specific benchmarks that should be met in terms of both process and outcome. The International Nutrition Survey is one activity that allows participating centers to participate in benchmarking activities.

Supplemental parenteral nutrition

In general, enteral nutrition is the preferred route for nutritional supplementation. A minimum of 50-65% of total caloric needs should be met by the enteral route in order to provide “enough” nutrition. Early enteral nutrition, within 48 hours, is of greater benefit than delayed enteral nutrition. However, early parenteral nutrition, regardless of caloric goals, is associated with worse outcome. Supplemental parenteral nutrition should be delayed until day 7.

Specific enteral routes

Whether enteral nutrition is associated with pneumonia remains a very controversial topic. In one retrospective analysis aspiration was most likely when patients are fed using the nasogastric route.
Pneumonia, as defined by the Clinical Pulmonary Infection Score, was associated with aspiration; when adjusted for aspiration there was no difference by route of administration. Measures to reduce the risk of aspiration are therefore extremely important, and the decision about which route to use may consider whether the patient is a high aspiration risk.

One clear disadvantage of the gastric route is the provision of prescribed calories. Patients fed in either the duodenum or jejunum are more likely to receive a greater percentage of prescribed calories.

**Perioperative feeding**

Many critically ill patients require multiple trips to the operating room; this is particularly true for trauma and burn patients. Patients receiving supplemental nutrition who are made NPO after midnight receive prescribed calories <10% of the time. Continuous feeding, up to and through the operation, is safe in burned patients. Jejunal feeding up to the time of operation is safe in nonabdominal surgery; a recent study suggests that this approach is not only safe but provides an additional 12 hours of feeding which translates into an additional 1065 kcal/day.

**Immunonutrition**

Immunonutrition is another controversial area of nutrition; one of the easiest ways to highlight the controversy is to compare the recommendations of the European Society for Enteral and Parenteral Nutrition (ESPEN), the American Society for Parenteral and Enteral Nutrition along with the Society for Critical Care Medicine (ASPEN/SCCM) and the Canadian Critical Care Practice Guidelines (CCCPG).

**Arginine**

Arginine is a conditionally essential amino acid that has effects on collagen synthesis, lymphocyte proliferation, and wound healing. It is the sole precursor for nitric oxide synthesis. An arginine deficiency occurs in critical illness due to arginase release from granulocytes; this subsequently results in T receptor abnormalities leading to impaired wound healing and a predisposition to infection. As a result, arginine is recommended by ASPEN and ESPEN in trauma patients, although it is not recommended by the CCCPG due to lack of benefit. In severe sepsis, there are increased levels of arginine and studies have demonstrated harm with arginine supplementation in this population, so it is not recommended for these patients.

**Glutamine**

Glutamine is a conditionally essential amino acid. It has anti-inflammatory properties, may function as an immune modulator, and reduces bacterial translocation. Greatest outcome benefits have been after surgery and in patients with acute pancreatitis, with intravenous supplementation. Currently, there is not an intravenous formulation available, and the results with enteral supplementation have been less impressive. It is recommended in trauma and burn patients by all three groups.

**ω-3 and ω-6 fatty acids**
Polyunsaturated fatty acids are not synthesized by the body and must be obtained by dietary supplementation. Supplementation has been shown to decrease the production of inflammatory cytokines, IL-1, tumor necrosis factor α, and prostaglandin E₂ while increasing the production of interferon gamma and lymphocyte proliferation. Specific benefit in terms of ventilator days, ICU days, new organ failure, and mortality has been seen in patients with acute lung injury and ARDS. It is recommended by all 3 societies.

**Peptic ulcer prophylaxis**

Critically ill patients, particularly those ventilated >48 hours, are at risk for stress gastritis. Providing peptic ulcer prophylaxis decreases the risk of stress gastritis in these patients; however, enteral nutrition appears to provide the same or similar benefit, as there is no additional benefit seen in providing peptic ulcer prophylaxis to those patients receiving enteral nutrition when the outcome of interest is gastrointestinal bleeding. In addition, the risk of pneumonia is increased in patients receiving enteral nutrition who also receive peptic ulcer prophylaxis.

**Pancreatitis and antibiotics**

Although the question is still open to debate in some arenas, a recent meta-analysis comparing studies published prior to 2000 to those after 2000 demonstrated that the older literature clearly favors empiric antibiotics for severe pancreatitis, while the data published after 2000 does not show any benefit to that practice.

**Diagnosis of C. difficile**

There are several new tests available that make the diagnosis of the presence of C. difficile. The question involves a balance of sensitivity and specificity for true disease. PCR amplification detects toxin B, has a very rapid turnaround time and may decrease time in isolation, improving patient and caregiver satisfaction while cost neutral.

**New treatments for C. difficile**

Laparoscopy with creation of a loop ileostomy, washout of the distal colon with warmed polyethylene glycol solution and postoperative treatment with antegrade vancomycin enemas is a new strategy that shows promise in severe C. difficile associated disease. A nonvalidated scoring system was used to classify patients into severity categories, and comparison with historically treated controls demonstrated improved mortality. One of the advantages of this strategy is early surgical consultation and involvement in the care of a very critically ill patient.

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