

E-Table 68-3). These strategies take into account the relative inability of catabolic patients to efficiently utilize exogenous nutrients and knowledge that most protein and lean tissue repletion occurs over a period of several weeks to months during post-hospital convalescence. Adequate nonprotein energy is essential to allow amino acids to be effectively used for protein synthesis and not oxidized for production of energy (adenosine triphosphate, or ATP). The ratio of nonprotein calories to nitrogen used in most centers typically ranges from 75:1 to 125:1. Because nitrogen = protein/6.25, this equates to 75 to 125 nonprotein kilocalories for each 6.25 g of protein or amino acid administered.

NUTRITIONAL SUPPORT

Table 68-2 lists common clinical scenarios in which specialized oral/EN or PN support may be indicated. In these settings, consultation with a multidisciplinary nutrition support team, if available, has been shown to reduce complications and costs and to increase the appropriate use of EN and PN in both academic and community medical centers.

Oral Nutrition Support

Oral nutrition supplementation includes provision of balanced oral diets of usual foods supplemented with complete liquid (or solid) nutrient products, protein supplements (e.g., hydrolyzed whey or casein powder that can be mixed with dietary beverages), high-potency multivitamin-multimineral supplements, and/or specific micronutrients required to treat a diagnosed deficiency (e.g., zinc, copper, vitamin B₆, vitamin B₁₂, vitamin D). Special supplements designed for patients with chronic renal failure (featuring concentrated calories and low amounts of protein and electrolytes) are available, as are a variety of formulations designed for other specific disease categories (see later discussion). Several studies have shown that convalescence after stresses such as total hip replacement or gastrointestinal surgery

is enhanced with the addition of one or two containers per day of complete liquid nutrient supplements. These provide calories, carbohydrate, high-quality protein, fat, and micronutrients; are lactose and gluten free; and may contain small peptides and medium-chain triglycerides to facilitate absorption of amino acid and fat, respectively. Some formulations also contain soluble fiber or prebiotics (e.g., fructo-oligosaccharides) designed to decrease diarrhea. It is probably prudent to place outpatients who exhibit or are at risk for undernutrition (see E-Tables 68-1 and 68-2) and can tolerate oral medications on a potent oral multivitamin-multimineral preparation, at least for several months.

Administration of Enteral Tube Feeding

Patients with conditions outlined in Table 68-2 may have a functional gastrointestinal tract and yet be unable to consume adequate diet orally due to medical or surgical conditions (e.g., mechanically ventilation, pancreatitis, dementia, dysphagia, trauma or burns). Although PN is commonly administered in these settings, this practice is not evidence based; academic guidelines strongly suggest that oral nutritional supplements or enteral tube feedings should be used if specialized nutrition support is indicated in patients with a functional gastrointestinal tract ("if the gut works, use it"). E-Table 68-4 shows major characteristics of common complete liquid tube feeding formulations and the types of patients for which these are typically prescribed. These products can be used for oral nutrient supplementation as tolerated. When delivered in appropriate amounts, the liquid diets provide complete nutrition for most patients, although some ICU patients and patients with malabsorption or other conditions may have special needs (see later discussion).

The feedings can be delivered by conventional nasogastric tubes into the stomach or by small-bore nasogastric or nasojejunal tubes, percutaneous gastrostomy or jejunostomy tubes, or percutaneous gastrojejunostomy tubes (in which the gastric port may be used for suction and the jejunal port for feeding). Gastric feedings can be administered by either continuous or bolus feeds, whereas small bowel feeds must employ a continuous slow infusion using an infusion pump to avoid diarrhea. Tube feedings should be initiated at a slow rate (e.g., 10 to 20 mL/hour) for 8 to 24 hours and slowly advanced to the goal rate in 8- to 24-hour increments to deliver the calculated caloric and protein needs over the next 24 to 48 hours, depending on clinical tolerance and clinical conditions. Recent guidelines emphasize placing tube-fed patients in the semirecumbent position (e.g., increase head of bed), advancing feedings cautiously (with serial evaluations for diarrhea, nausea, emesis, abdominal distention, and significant gastric residuals), and using prokinetic agents and/or postpyloric feedings if gastric feedings are not well tolerated. Recent data suggest that higher volumes of gastric residuals (e.g., >250 mL) are usually well tolerated in patients being tube fed.

Primarily based on results of animal studies, EN is associated with improved gut barrier function, decreased infectious complications, less hypermetabolism, and decreased morbidity and mortality in catabolic models, compared with PN. Salutary clinical outcomes have been shown in randomized clinical trials in patients with pancreatitis receiving EN into the jejunum, compared with PN. Based on available data, recent guidelines for ICU patients by international expert panels and academic societies suggest that enteral tube feeds should be started within 1 to 3

TABLE 68-2 SOME CLINICAL INDICATIONS FOR SPECIALIZED ORAL/ENTERAL OR PARENTERAL NUTRITION SUPPORT

Patient currently exhibits moderate to severe protein or protein-energy malnutrition or has evidence of specific deficiency of one or more essential micronutrients
Patient with involuntary body weight loss of 5-10% or more of their usual body weight in the previous few weeks or months, weighs less than 90% of ideal body weight, or has a BMI lower than 18.5 kg/m ² .
Dietary food intake in a hospital or outpatient setting likely to be <50% of needs for more than 5-10 days due to underlying illness
Patient with severe catabolic stress (e.g., ICU care, serious infection) and adequate nutrient intake unlikely for >3-5 days.
After major gastrointestinal surgery or other major operation (e.g., hip replacement, partial organ resection)
Medical illness associated with prolonged (>5-10 days) GI dysfunction (diarrhea, nausea and vomiting, GI bleeding, severe ileus, partial obstruction) and/or short bowel syndrome, chronic or severe diarrhea, or other malabsorptive disorders
Clinical settings in which adequate oral food intake may be contraindicated or otherwise significantly decreased, such as respiratory or other acute or severe organ failure, dementia, dysphagia, chemotherapy or irradiation, inflammatory bowel disease, pancreatitis, high-output enterocutaneous fistula, alcoholism, drug addiction
Chronic obstructive lung disease, chronic infection, or other chronic inflammatory or catabolic disorders with documented poor nutrient intake and/or recent weight loss

BMI, Body mass index; GI, gastrointestinal; ICU, intensive care unit; PN, parenteral nutrition.

