Serum albumin is a negative acute-phase protein and hence a marker of the SRI. More severe hypoalbuminemia is a crude indicator of greater SRI severity, but this condition is almost certainly worsened by concurrent dietary protein deficiency. Despite the importance of adequate protein provision to patients with the SRI, no amount of SNS will raise serum albumin levels into the normal range as long as the SRI persists.

The SRI can be graded as mild, moderate, or severe. Examples of a severe SRI include (1) sepsis or other major inflammatory diseases (e.g., pancreatitis) that require care in the intensive care unit; (2) multiple trauma with an Injury Severity Score >20–25 or an Acute Physiology and Chronic Health Evaluation II (APACHE II) score >25; (3) closed head injury with a Glasgow Coma Scale <8; and (4) major third-degree burns of >40% of the body surface area. A moderate SRI occurs with less severe infections, injuries, or inflammatory conditions like pneumonia, uncomplicated major surgery, acute hepatic or renal injury, and exacerbations of ulcerative colitis or regional enteritis requiring hospitalization.

Patients with a severe SRI require the initiation of SNS within the first several days of care, for they are highly unlikely to consume an adequate amount of food voluntarily over the next 7 days. On the other hand, a moderate SRI, as is common during the period following major uncomplicated surgery without oral intake, may be tolerated for 5–7 days as long as the patient is initially well nourished. Patients awaiting elective major surgery benefit from preoperative nutritional repletion for 5–10 days but only in the presence of significant PEM. When adequate preoperative nutrition or SNS is impractical, early postoperative SNS is usually indicated. Furthermore, patients with a combination of a moderate SRI and moderate PEM are likely to benefit from early postoperative SNS.

RISKS AND BENEFITS OF SPECIALIZED NUTRITIONAL SUPPORT

The risks of enteral SNS are determined primarily by the patient's state of alertness and swallowing competence, the anatomy and function of the gastrointestinal tract, and the experience of the supervising clinical team. The safest and least costly approach is to avoid SNS by close attention to oral food intake; personal encouragement; dietary modifications; hand-feeding, when possible; and, often, the addition of an oral liquid supplement. For this reason, all patients at nutritional risk should be assessed and followed by a nutritionist. There is increasing interest in the use, under selected circumstances and when not contraindicated, of pharmacologic doses of anabolic steroids to stimulate appetite and promote muscle anabolism.

Nasogastric tube insertion is a bedside procedure, but many critically ill patients have impaired gastric emptying and a high risk of aspiration pneumonia. This risk can be reduced by placing the tip of the feeding tube in the jejunum beyond the ligament of Treitz, a procedure that usually requires fluoroscopic or endoscopic guidance. When a laparotomy is planned for a patient who has other surgical conditions likely to necessitate prolonged SNS, it is advantageous to place a jejunal feeding tube at the time of surgery.

A major disadvantage of enteral SNS is that the amounts of protein and calories provided to critically ill patients commonly fail to reach target goals within the first 7–14 days after SNS is initiated. This problem is compounded by the lack of enteral products that allow the provision of the recommended protein target of 1.5–2.0 g/kg without simultaneously inducing potentially harmful caloric overfeeding.

Enteral SNS is often required in patients with anorexia, impaired swallowing, or small-intestinal disease. The bowel and its associated digestive organs derive 70% of their required nutrients directly from nutritional substrates absorbed from the intestinal lumen. Enteral feeding also supports gut function by stimulating splanchnic blood flow, neuronal activity, IgA antibody release, and secretion of gastrointestinal hormones that stimulate gut trophic activity. These factors support the gut as an immunologic barrier against enteric pathogens. For these reasons, current evidence indicates that some luminal nutrition should be provided, even when PN is required to provide most of the nutritional support. The nonessential amino acids arginine and glutamine, short-chain fatty acids, long-chain omega 3 fatty acids, and nucleotides are available in some specialty enteral formulas and appear to have an important role in maintaining immune function. The addition of supplemental PN to enteral feeding (either by mouth or as SNS by enteral tube) may hasten the transition to full enteral feeding, which is usually successful when >50% of requirements can be met enterally. As long as protein and other essential nutrient requirements are met, substantial nutritional benefit can be achieved by providing ~50% of energy needs for periods of up to 10 days. As a rule of thumb, dietary protein provision should be increased by ~25–50% when energy intake is reduced by this amount, since negative energy balance reduces the efficiency of dietary protein retention. For longer periods and in patients who have a normal or increased body fat content, it may be preferable to provide only 75–80% of energy needs (together with increased protein), as the mild energy deficit improves gastrointestinal tolerance, makes glycemic control far easier, and avoids excess fluid administration.

The main risks of PN are related to the placement of a central venous catheter, with its complications of thrombosis and infection, and the relatively large intravenous volumes infused. Less often appreciated are the risks associated with the ease of inadvertently infusing excessive carbohydrate and lipid directly into the bloodstream. These risks include hyperglycemia, inadequate lipid clearance from the circulation, hepatic steatosis and inflammation, and even respiratory failure in patients with borderline pulmonary function. On the other hand, renal dysfunction does not reduce a patient's requirement for protein or amino acids. In cases in which renal function is a limiting factor, appropriate renal replacement therapy must be provided along with SNS.

In the past, bowel rest through PN was the cornerstone of treatment for many severe gastrointestinal disorders. However, the value of providing even minimal amounts of enteral nutrition (EN) is now widely accepted. Protocols to facilitate more widespread use of EN include initiation within 24 h of ICU admission; aggressive use of the head-upright position; use of postpyloric and nasojejunal feeding tubes; use of prokinetic agents; more rapid increases in feeding rates; tolerance of higher gastric residuals; and adherence to nurse-directed algorithms for feeding progression. Parenteral SNS alone is generally necessary only for severe gut dysfunction due to prolonged ileus, intestinal obstruction, or severe hemorrhagic pancreatitis.

In critically ill patients, parenteral SNS can be commenced within the first 24 h of care, with the anticipation of a better clinical outcome and a lower mortality risk than those following delayed or inadequate enteral SNS; however, this point remains controversial. Some evidence suggests that early SNS is associated with a reduced risk of death but also with an increased risk of serious infection. More recent data, obtained in studies of moderately critically ill patients, suggest that early hypocaloric parenteral SNS lessens morbidity and mitigates muscle atrophy without an increased risk of infection, but also without a detectable reduction in mortality risk. Unfortunately, the current clinical-trial evidence fails to address several important unknowns. It is important to note that the level of protein substrate provided in published clinical trials generally falls well below the current recommendation, even in trials of supplemental parenteral SNS. Much of the increase in morbidity associated with parenteral and enteral SNS can be ascribed to hyperglycemia, which can be prevented by appropriately intensive insulin therapy. The level of glycemia necessary to prevent complications, whether <110 mg/dL or <150 mg/dL, remains unclear. Adequately fed surgical patients may benefit from the lower glucose range, but studies of intensive insulin therapy alone, without full feeding, suggest improved morbidity and mortality outcomes with looser control of glucose at <180 mg/dL.

In the early years of its use, PN was relatively expensive, but its components now are often less costly than specialty enteral formulas. Percutaneous placement of a central venous catheter