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Review

Indications for total parenteral nutrition in the hospitalized patient: A prospective review of evolving practice

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The indications for initiating total parenteral nutrition (TPN) were prospectively evaluated in 100 consecutive patients at a tertiary referral hospital with a long-standing Nutritional Support Service to illustrate the reasons why the parenteral route was chosen at this unique institution in terms of patient population. Sixty male and 40 female patients, average age 59 ± 17 years (range 22–86 years), were classified a priori as to the underlying reasons for initiation of TPN. The study was conducted by a Nutrition Support Service at this hospital without pediatric, trauma, or burn services specializing in the care of patients with diabetes mellitus. Of the 100 patients, 63% were from the surgical service; 24% had diabetes mellitus. Their mean weight (118 ± 29% of ideal), body mass index (25 ± 6 kg/m^2), and serum albumin (2.8 ± 0.7 g/dL) indicated a reasonable body composition with a moderate systemic inflammatory response. Six patients received preoperative TPN for an average of 5 ± 3 days with a variety of diagnoses including malignancy, Crohn's disease, bowel obstruction, and gastrointestinal bleeding. The underlying reasons for initiating nutritional support were related to three factors that largely determine the need for involuntary feeding: preexisting protein calorie malnutrition, actual or anticipated semistarvation for a prolonged period, and the presence of a systemic inflammatory response. The choice of TPN was based on anticipated or proven intolerance to full enteral feeding. The duration of time before initiation of TPN postoperatively was 6 ± 5 days, which reflects our policy that initially well-nourished patients who are experiencing a systemic inflammatory response should not undergo more than 5 to 7 days of inadequate feeding. The duration of TPN overall was 11 ± 10 days, which primarily illustrates the dramatic reduction in length of hospital stay that has occurred throughout the health care system and the willingness to provide TPN in alternative settings including transitional care units, rehabilitation hospitals, and for short-term care, the patient's home. The most common specific reasons identified for initiating TPN rather than enteral nutrition were ileus (25%), an underlying acid-base or electrolyte/mineral disorder (13%) requiring correction, and the convenience of TPN because a central venous catheter was in place (12%). The usual indication for nutritional support at this tertiary referral and specialty hospital was actual or impending protein calorie malnutrition. TPN was chosen for a variety of reasons related to actual or anticipated tolerance to enteral feeding. This audit demonstrates that our TPN practice has evolved in relation to time of initiation and duration of feeding, which reflect a clearer appreciation of the risks and benefits of TPN. (J. Nutr. Biochem. 10:2–7, 1999)

Introduction

Recently there has been renewal of interest in the preferred use of enteral over parenteral nutrition. The concept of bacterial translocation from the intestine systemically, although shown definitively only in animal models, has been linked to the type and amount of enteral feeding.[1] However, there has been little support for bacterial translocation as a common phenomenon in experiments in humans.[2,3] Although enteral feeding also is presumed to be safer, a critical review of several studies supporting this thesis[4,5] have a critical flaw in that substantially more calories were given to

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the group receiving total parenteral nutrition (TPN). In cases in which a similar amount of energy was provided to trauma or postoperative patients, there was no difference noted in morbidity.[6,7]

Given these considerations, there is less reluctance on our part to use TPN when certain clinical circumstances either totally preclude or limit the use of enteral nutrition. However, enteral nutrition is less expensive and further along in the transition to oral feeding and the goal is to convert patients rapidly from parenteral to enteral nutrition. In view of this interplay, we were interested in classifying the reasons for the choice of TPN in a prospective series of patients referred to the Nutrition Support Service (NSS) at a tertiary referral hospital that does not admit pediatric, trauma, or burn patients and specializes in the management of diabetes mellitus and its complications. The initiation of nutritional support in present-day practice at our institution is principally based on actual or impending protein calorie malnutrition, defined by body composition (usually by presenting weight loss), days of actual or anticipated semi-starvation, and the presence and severity of a systemic inflammatory response[8] rather than the underlying disease process. The practical reasons why a choice was made to use TPN rather than enteral feeding to accomplish this has not been examined previously.

Methods

Patients

Data on 100 consecutive patients who received consultative services from the NSS during an 8-week period (January 20 to March 16, 1995) were collected. The usual practice is that the primary service requests an opinion whether TPN is indicated. If there is mutual agreement TPN is provided by the NSS. Nutritional support is routinely provided to patients who are malnourished, which is determined by simple measures of body composition [weight/height, percent weight loss, body mass index (BMI), upper arm anthropometry]; experiencing a systemic inflammatory response [fever, leukocytosis, bandemia (increase in immature polymorphonuclear leukocytes)]; and semistarving (less than 50% of energy and protein needs) for more than 5 days. TPN is provided by day 7 if the patient was initially well nourished, and sooner if either severely inflamed by clinical judgment or severely malnourished (greater than 15% weight loss, arm muscle circumference less than the fifth percentile, serum albumin <3.0 g/dL). The choice of 5 to 7 days support for most patients is based on clinical grounds and certain key studies. For instance, well nourished lean individuals experiencing complete caloric deprivation died after 6 to 11 weeks in the Irish prisoner experience.[9] Critically ill individuals lose lean tissue at at least three times the rate of total fasting. Thus, a period of 2 weeks of semistarvation should certainly be considered too long for such patients. Furthermore, in a large randomized trial of TPN after major surgery involving 300 patients, approximately 60% of patients were able to eat within 8 to 9 days postoperatively, suggesting that 7 days would be a reasonable cut off to reduce the number of patients who would receive TPN without likely benefit.[10] In this same study, patients receiving 10 days of glucose-only feeding had a significantly higher morbidity and mortality experience.[10] Thus, once again, 14 days is obviously too long. Finally, immediate and adequate parenteral and enteral feeding immediately postinjury in the most catabolic patients—those with closed head injury—has improved clinical outcome compared with delayed feeding.[11–13]

Table 1 Reasons for initiation of total parenteral nutrition

1. Intolerant of tube feeds—failed trial (unable to meet full nutritional needs due to abdominal distention, gastric residuals >100 cc, vomiting, diarrhea) (6)*
2. Hypotension requiring pressor drugs (7)
3. Bowel obstruction (suspected or actual) (11)
4. Ileus (high gastric residuals) (25)
5. Actively weaning to extubate from artificial ventilation (7)
6. Severe pancreatitis (>2 Ranson criteria[31]) (2)
7. Inflammatory bowel disease requiring complete bowel rest due to obstruction and/or failure to respond to medical therapy (0)
8. Intestinal fistula (documented radiographically or endoscopically) (4)
9. Parenteral correction of severe metabolic disorder (acid/base disturbance, serum electrolyte/mineral abnormality) (13)
10. Short bowel syndrome (remaining intestine inadequate to maintain nutritional status) (8)
11. Psychologic-based refusal of enteral nutrition (anorexia nervosa, depression) (0)
12. Severe protein-calorie malnutrition (>20% weight loss, <80% ideal body weight, arm muscle circumference <10th percentile, serum albumin <2.5 g/dL) (6)
13. Active gastrointestinal bleed (requiring transfusion or colloid replacement) (2)
14. Esophageal varices (0)
15. Enteral feeding probably possible but central catheter already in place (12)
16. Bowel rest for suspected or actual perforation (6)
17. AIDS anorexia/malabsorption (10)
18. Poor cardiac status (i.e., ejection fraction <0.3), suspect enteral feeding will be detrimental (1)

*Number in parentheses is patient number. Total is greater than 100 because some patients had more than one indication.
AIDS—acquired immunodeficiency syndrome.

Data collection

All patients were prospectively classified according to their indications(s) for the use of TPN on the day the NSS consultation request was received. A list of 15 possible reasons why TPN rather than enteral nutrition might be initiated was determined a priori. Several patients were unable to be classified by the original list; therefore, three additional reasons were added (numbers 16, 17, and 18 in *Table 1*) during the early course of the study. Other data that were prospectively collected included: age, gender, assessment of nutritional status including weight, percent ideal body weight (IBW; (determined using the adjusted 1959 Metropolitan Life Tables), BMI (weight in kg/height^2 in meters), serum albumin concentration, triceps skinfold and arm muscle circumference, whether admitted to surgical or medical service, presence of diabetes, presence of a central catheter at time of NSS consultation request, number of patients receiving preoperative TPN, total number of days receiving TPN, tube feeds and/or oral diet, total number of days followed by the NSS, and the reason why the patient was discharged from the NSS. Values are reported as mean $\pm$ standard deviation unless otherwise specified.

Results

A total of 100 consecutive patients were consulted for nutrition support over the 8-week period. There were 60 males and 40 females ranging in age from 22 to 86 years (mean 59 $\pm$ 17 years). Of the 100 patients, 24% had diabetes, with the majority having type II diabetes (20 of 24 patients or 83%). Weight ranged from 40.0 to 150.8 kg (mean 72 $\pm$ 19.1 kg), which was 60 to 254% IBW (mean

118 ± 29). BMI, with a normal range of 20 to 25 was 13 to 54 kg/m^2 mean 25 ± 6) kg/m^2). Upper arm anthropometric measurements were done in 40 patients, usually performed when severe fluid retention was thought to mask underlying protein calorie malnutrition (PCM). Twenty-five (83%) patients had an upper arm muscle circumference of less than the tenth percentile, reflecting moderate to severe PCM. Serum albumin level averaged 2.8 ± 0.7 g/dL (range 1.7–4.7 g/dL). These results reflect the dual nature of hospital PCM, which includes those who are initially malnourished by body composition measurements and those who will become malnourished rapidly through semistarvation and a systemic inflammatory response, which will not be reflected by conventional measures of body composition.

The reasons why patients were initiated on TPN rather than enteral nutrition and the number for each indication is shown in *Table 1*. The most common reason for initiating TPN was the presence of an ileus (defined by a high nagogastric output and/or by radiographic evidence). Although potential intolerance was presumed rather than proven in this group, the greater rapidity of reaching nutritional goals with TPN in our experience and others,[4,5] with limited safety and efficacy concerns if overfeeding is avoided make TPN a reasonable choice. Of the patients experiencing ileus, 92% had undergone surgery 6 ± 5 days (0–22 days) prior to beginning TPN. Although aggressive placement of nasojejunal tubes might have been employed in certain instances, postoperative tube placement into the jejunum is often difficult, is less successful, and can be a significant additional expense because of the use of radiologic or endoscopic procedures.

The second most common reason for initiating TPN was the need for parenteral correction of a severe metabolic disorder defined as acid-base, electrolyte, or mineral imbalance, most commonly a metabolic alkalosis requiring administration of hydrochloric acid. Although the addition of calcium chloride to enteral formulas will correct metabolic alkalosis, amounts that can be provided in this manner are limited. Furthermore, calcium chloride is less effective than hydrochloric parenteral acid, and calcium chloride tends to lead to clogging of feeding tubes when fat-containing formulas are used. Finally, enteral correction of hypopotassemia is similarly limited in amounts and rate of delivery due to enteral intolerance.

The third reason TPN was initiated was that, even though enteral nutrition might have been possible, the patient already had a central catheter in place. In fact, the majority of patients (86%) consulted for nutritional support already had a functioning central venous catheter. This was due to the large number of patients who had undergone surgery prior to initiating nutritional support and the nearly universal use of central access in critically ill patients, both for monitoring and for drug administration.

Of the 100 patients consulted for nutrition support, 63 were surgical patients. The three most common types of surgical procedures performed were cardiac (coronary artery bypass graft and/or valve replacement), general abdominal (repair of fistula, ulcer, or perforated appendix; small or large bowel resection for benign disease; cholecystectomy; appendectomy), and oncologic (resections related to upper and lower gastrointestinal malignancies). The principal service at the time of NSS consultation is shown in *Table 2*. Seven of the medical patients later underwent surgical procedures while receiving care from the NSS.

Table 2 Principal service of nutrition support service consultation

Service	Number of patients
Cardiac surgery	18
General surgery	14
Surgical oncology (gastrointestinal)	12
Gastrointestinal (no surgery)	11
Infectious disease (AIDS)	10
Medical oncology	7
Vascular surgery	6
Transplant surgery (liver)	4
Transplant, other (TIPS, shunts)	4
Pulmonary	4
General medical	3
Cardiology	2
Urologic surgery	2
Thoracic surgery	2
Neurologic surgery	1

AIDS—acquired immunodeficiency syndrome. TIPS—transvenous intrahepatic portosystemic shunt.

The gastrointestinal status of those patients who received TPN due to an ileus was reassessed 7 days after initiation. On day 7, slightly more than half (52%) of the patients no longer required TPN, because their ileus had completely resolved and they were eating a regular diet. Six (24%) of 25 such patients were receiving either a clear liquid or full liquid diet by day 7 in addition to being supplemented with TPN. The remaining 24% of the patients still exhibited symptoms of an ileus (i.e., high nasogastric tube output) on day 7 and subsequently continued to receive their full nutritional needs via TPN.

Six patients were consulted for the initiation of preoperative parenteral nutrition. In four cases, the patients were unable to eat due to an obstruction or stricture related to either an upper abdominal malignancy ($N = 3$) or Crohn's disease ($N = 1$) and the surgery was delayed to provide feeding. In the fifth case the patient was awaiting repair of a fistula, and in the sixth case the patient was experiencing active upper gastrointestinal bleeding that did not require emergency repair with central access in place and there was a reluctance to feed enterally by the primary service. These six patients received preoperative TPN for an average of 5 ± 3 days (range 1–9 days).

Patients were followed by the NSS for an average of 12 ± 10 days (range 1–51 days). TPN was provided for 11 ± 10 days (range 1–51 days), enteral nutrition for 2 ± 4 days (range 2–26 days), and an oral diet for 3 ± 4 (range 0–20 days). Seven percent of the patients received their full nutritional needs by TPN for the entire time they were followed by the NSS. In five instances, this was because the patients expired before initiation of tube feeding or an oral diet. In the other two cases, the patients were supported solely by TPN in the hope that their fistulas would heal with conservative management; however, both of these patients were discharged on home TPN.

Approximately half (51%) of the patients had TPN discontinued, usually on the advice of the NSS, because

they were eating solid food and drinking substantial amounts of fluid. In most instances, TPN was stopped because the patients were able to consume at least 1,000 kcal and 1,000 mL of fluid. However, in some cases TPN was stopped at the request of the patient's primary team without regard to these general goals, because the patient was deemed medically stable and ready for discharge. Of the patients whose TPN was stopped, 22% were transitioned to enteral feeding via a tube, 16% were discharged on home TPN, which principally reflects the large (30–40 patients) group of such patients followed chronically at our institution, and 4% were discharged to either a rehabilitation or chronic care facility on TPN. Five of the patients expired unrelated to feeding and two were still receiving TPN 30 days after the last patient had been entered into the study.

The NSS was reconsulted six times in five patients. In two instances, the patients were restarted on TPN because they underwent surgery and it was anticipated that they would not be able to eat for more than 7 days postoperatively. In another case, the patient developed an empyema and feeding via the enteral route was temporarily discontinued, necessitating the reinstitution of TPN. The need for TPN to be restarted in these three patients could not have been predicted. There were, however, three instances occurring in two patients where the TPN may have been stopped prematurely and the failure of enteral feeding might have been predicted. One patient was reconsulted twice because of a prolonged ileus that precluded her from being able to maintain an adequate oral intake. The second patient was intubated for a prolonged period and failed a trial of nasogastric tube feeding (i.e., high residuals). Given the clinical status of the latter two patients, it was not unreasonable to suspect that enteral feeding would not be tolerated. Thus, it probably would have been prudent to continue the TPN until it was apparent that these patients could be successfully transitioned to the enteral feeding route. A note of how the NSS functions may help explain how this occurs. The NSS is consulted to provide TPN, but only at the request of the primary service. When TPN is no longer required or requested, particularly on the surgical services, their nutritional care is transferred to the primary service, which includes many residents and attendings who have gained nutritional expertise from prior service with the NSS.

Discussion

The systemic inflammatory response is characterized by a state of hypercatabolism and hypermetabolism, which occur in medical and surgical patients suffering from a wide array of disease conditions. However, patients undergoing surgery that in itself elicits a very modest and short-lived injury response can develop infective or wound complications that increase and prolong the systemic inflammatory response. These complications are often accompanied by postoperative ileus, which makes TPN more likely to be necessary to prevent the consequences of malnutrition. Therefore, as might have been anticipated, the majority of our patients were from the surgical services, and the major indication for the initiation of TPN was "poor gut function." This symptom complex was associated with a variety of different conditions including prolonged ileus, short bowel syndrome, intolerance to tube feeding, pancreatitis, active gastrointestinal bleeding, and bowel obstruction or perforation. Could enteral nutrition have been performed in some patients? The answer is, of course, yes. However, given the relative safety and efficacy of TPN versus enteral feeding,[6,7] we have not considered proof of failure of enteral nutrition as the only accepted indication of TPN. When relative cost and likelihood of achieving nutritional goals become the principal considerations, then only a reasonable likelihood of enteral feeding intolerance becomes a relative indication for TPN in our estimation. Furthermore, the costs of TPN in the current climate should be reevaluated, because amino acids and glucose are now commodity items, catheter placement and care are generally not specifically for TPN, and biochemical monitoring specifically for TPN is extremely limited.

In 25% of patients the indication for starting TPN was prolonged ileus, and the majority of these patients (92%) were from the surgical services. This is not surprising, because 36% of the patients in the ileus category had diabetes, which is known to impair gastrointestinal motility due to gastroparesis and other disturbances of intestinal motility. Typically in the absence of diabetes, colonic motility following a laparotomy may be impaired for 3 to 5 days, and gastric motility for 1 to 2 days. However, small bowel motility is minimally affected by the systemic inflammatory response, and patients generally can be fed via jejunostomy in the postoperative period.[14,15] However, if these tubes are not placed at the time of surgery, either as nasoenteric tubes or surgically, there is considerable reluctance to, as well as greater difficulty in, providing this access in the postoperative period. For the ileus group of patients the total period that they received TPN was 12 ± 12 days, which was similar to the overall group. More than 80% of patients had a central venous catheter in place at the time of the initial consultation. Hence the potential for pleural and mediastinal complications with central venous catheter placement, which usually are in the range of 4 to 5%,[16] was not a primary concern.

The role of perioperative TPN has been extensively evaluated in several populations of patients undergoing major thoracoabdominal surgery. The available data do not support the routine use of preoperative TPN, because no improvement in overall mortality or morbidity was observed.[17] In 1987 this metaanalysis of perioperative TPN reviewed the results of 18 studies. From the available data these authors concluded that there was not a role for perioperative TPN in well nourished patients, but they reserved judgment on its role in mild or moderately malnourished patient populations.[17] Subsequently the Veterans Administration Multi-institutional Co-operative Study[18] was undertaken, in which 459 patients were randomized to receive either perioperative TPN for 7 to 15 days prior to the surgery and up to 3 days postoperatively or standard care (control). Following surgery these patients were monitored for a period of 90 days to identify any complications. Mortality rates of 13.4% and 10.5% in the TPN and control groups, respectively, were noted. The rates of major complications between the two groups were nearly identical: TPN 25.5%, control 24.6%. However, the infectious complications were greater in the TPN group (14.1% vs. 6.4%;

$P = 0.01$), whereas there was a greater number of noninfectious complications in the control group (22.2% vs. 16.7%). After further stratification of the groups according to the degree of malnutrition, it was evident that only in the severely malnourished subgroup was there an obvious benefit, because there was no difference in the infectious complications but there were fewer noninfectious complications (42.9% vs. 5.3%; $P = 0.03$ in the group receiving TPN). The overall rate of major complications, both infectious and noninfectious, in those receiving TPN in this subgroup were also lower and marginally significant (25.8% vs. 47.4%; $P = 0.12$). More recently a consensus conference sponsored by the National Institutes of Health, the American Society for Parenteral and Enteral Nutrition, and the American Society for Clinical Nutrition has concluded that, on the basis of available randomized clinical trials, preoperative TPN provided to malnourished patients—defined by weight loss and plasma proteins—significantly reduces postoperative complications.[19] Based on data such as this, it has been our policy to reserve preoperative TPN for the uncommon patient with severe malnutrition (i.e., albumin <2.5 g/dL, $>20\%$ weight loss, or $>30\%$ lean tissue loss by anthropometry, creatinine excretion, or body composition measurement), which generally occurs in 5% or less of patients referred for TPN in most acute care hospitals. In patients who are mildly malnourished ($<10\%$ weight loss, albumin >3 g/dL, or $<15\%$ lean tissue loss) prior to surgery, TPN is considered postoperatively if enteral feeding is not substantially established by day 5 and by day 7 in initially well-nourished ($<5\%$ weight loss, albumin 3.5 g/dL or greater). This policy is also consistent with recommendations by the expert committee.[19] Moderately malnourished patients with intermediate values by nutritional assessment may begin to receive feeding in the early postoperative period. In our study there was a 6 ± 8 day interval from the time of the surgery until the NSS was consulted, which suggests a slightly longer period in practice, because malnutrition varied from mild to severe in this group of patients.

Prior to the present era of cost containment, the average duration of TPN was approximately 21 days.[16,20] The data in our study revealed that the duration of TPN has been substantially reduced to 11 ± 10 days, which we attribute to the general trend for shortened hospitalization and the use of alternate sites for medical care. The ability to employ TPN in less intense settings such as transitional care and rehabilitation units has increasingly led to earlier discharge from acute care facilities, where TPN remains the major reason for acute care hospitalization, thereby reducing health care costs. This outcome is reflected in the 20% of patients in this study who were discharged to rehabilitation facilities or on home TPN, although the latter represent a number of patients from our large home TPN population who are periodically admitted for complications of their disease or for infections of their permanent catheters.

In terms of nutritional status of the patients receiving TPN in this survey, the mean BMI was 25.4 ± 6.1 kg/m^2, suggesting reasonable nutrition by this rough estimate of lean tissue. However, the mean serum albumin of 2.8 ± 0.7 g/dL reflects a moderate systemic inflammatory response on average but ranging from severe (1.7 g/dL) to absent (4.7 g/dL). Furthermore, an arm muscle circumference of less than the 10th percentile in 25% (63% of those measured) of the patients is consistent with a substantial loss of body cell mass in a number of patients.

The prevalence of PCM is related to the underlying disease state; for instance, 65% of patients with pancreatic cancer, 60% with carcinoma of the stomach and esophagus are malnourished at presentation.[21] This reflects the underlying condition necessitating consideration for surgery. From data previously discussed, only when PCM is severe would preoperative TPN be likely to provide a net benefit. In the earliest, large randomized trial of preoperative TPN, Muller et al.[22] studied patients undergoing surgery for upper gastrointestinal tract tumors. Patients who received routine preoperative TPN demonstrated a reduction in postoperative complications, as well as a decrease in perioperative mortality compared with controls consuming an oral diet (mortality rate of 4% TPN vs. 29.4% control, and complication rates of 18% and 38.9% in TPN and controls, respectively). Although a subsequent study by the same authors states that a third arm was actually present in that study—one that continued intravenous lipid given discontinuously that showed no benefit over control[23]—it is now thought this may have been due to too rapid administration of fat emulsion, which should not exceed 0.11 g/kg/hr.[24] A more recent study of TPN with and without fat in critically ill trauma patients has confirmed the adverse effects,[25] due presumably to too rapid infusion of fat emulsion. However, postoperative TPN for the initially better nourished is less effective at improving outcome if given routinely, unless certain factors are considered such as underlying prognosis and likelihood of an uncomplicated postoperative course. For instance, Brennan et al.,[26] in a prospective randomized trial of postoperative TPN following surgery for a pancreatic cancer, found no benefit in terms of mortality or the duration of hospitalization. Caloric intakes were 34 to 39 kcal/kg/day with estimated energy requirement of 25 kcal/kg.[27] Energy intakes greater than 35 kcal/kg/day are likely to produce hyperglycemia in the majority of patients,[28] which is an important risk factor for infection,[29] which was one of the most common complications in the TPN group in that study.[26] However, TPN was provided routinely in the early postoperative period to all in the treatment arm regardless of initial nutritional status or duration of semistarvation. Furthermore, the underlying prognosis in this condition is unlikely to allow a substantial benefit in any event, particularly if not targeted to those who are failing to progress to enteral nutrition. Similarly, in the large randomized trial of routine postoperative TPN after major surgery mentioned earlier, Sandstrom et al.[10] did not consider initial nutritional status or a defined period of semistarvation, which would have likely made TPN unnecessary or not indicated in more than half of the patients. Although there was no net benefit in the overall group, there were two subgroups identified, one approximately 20% of the total who would have likely benefited from TPN, and another also approximately 20% of the total who may have been harmed by TPN.[10] This is one of the principal reasons why we employ selection criteria for TPN therapy based on nutritional status (body composition), duration of semistarvation, and the presence and extent of the systemic inflam-

matory response and then the likelihood of progression to enteral feeding. Such a system results in fewer individuals receiving TPN than routine provision for all postoperative patients, and those who do receive TPN are presumably more likely to benefit.

Approximately 10% of our patients had the diagnosis of acquired immunodeficiency syndrome (AIDS) and the majority of these were receiving home TPN. In a study of the determinants of predictive markers in hospitalized AIDS patients,[30] body weight was an independent prognostic marker in predicting survival (i.e., median survival of 6 months vs. 9 months if the ideal body weight was $<$90% or $>$90%, respectively). In patients with end-stage AIDS, with progressive underlying multiple opportunistic infections, TPN use generally is not warranted.[19] Although nutritional support has been a factor in delaying the wasting due to AIDS cachexia, and thereby improving quality of life, TPN seems particularly helpful only for the AIDS patient with predominantly gastrointestinal symptoms and PCM, with less evidence for benefit in those with generalized systemic inflammatory response. More recently there has been a dramatic reduction in the number of AIDS patients receiving home TPN at our institution with the advent of the protease inhibitors for antiretroviral therapy.

An interesting feature of this study was that once patients were discharged from the NSS, 95% did not subsequently require TPN during that hospitalization. The principal criterion used in our decision to discontinue the TPN successfully was that the patients had transitioned with the combined enteral and parenteral approach to tolerate at least 1,000 cc fluid and 1,000 kcal/day, or about half of their resting energy expenditure (i.e., 12 kcal/kg/day enterally).

In summary, although there are well established guidelines for TPN use, these are generally listed by specific disease states. However, in our clinical experience at a tertiary referral hospital not providing pediatric, trauma, or burn care, and specializing in the care of diabetes mellitus, the schema we employ for TPN is related to three principal variables: presenting nutritional status (i.e., body composition), duration of inadequate feeding, and presence and severity of the systemic inflammatory response, and then whether enteral feeding is possible, desirable, or convenient.

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