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Short Bowel Syndrome

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Abstract. The short bowel syndrome is a symptom complex that occurs in adults who have less than 200 cm of jejunum-ileum remaining after intestinal resection. Similar symptoms are observed in infants and children following massive bowel resection or congenital anomalies and in individuals with longer segments of intestine with severe mucosal disease. Initial care should focus on a thorough excision of nonviable bowel, an exact measurement of the remaining viable bowel, placing all intestine in continuity at the initial or subsequent operation, and controlling initial food intake. With time, adaptation of the remnant intestine occurs, and absorptive function may be maximized by enhancing the enteral diet and minimizing parenteral nutrition. Growth factors and specialized nutrients may also enhance this process. Intestinal transplantation should be considered in selected individuals with the short bowel syndrome who fail intestinal rehabilitation protocols.

Over the past century, surgeons have made dramatic progress in the care of patients undergoing gastrointestinal resections, and the history of the treatment of individuals with the short bowel syndrome illustrates this point. Not only have more patients survived and experienced an improved quality of life, but surgeons have contributed significantly to the understanding of intestinal physiology and cell kinetics through their clinical observations and laboratory research. The first reported successful intestinal resection was performed in 1880 [1], and it was only a short time later that a relation was established between the length of bowel resected and long-term survival [2]. In 1935 Haymond reported a large series of patients who had undergone bowel resection [3]. His analysis of 257 cases led to the conclusion that near-normal intestinal function could be expected after resection of about one-third of the small bowel, but loss of 50% of the small intestine was considered the upper limit of safety.

During the next several decades major advances were made in the fields of anesthesia, management of fluid resuscitation, and use of antibiotics, all areas that enhanced the care of the patient undergoing laparotomy. It was not until the 1960s that methods became available to support patients who survived extensive bowel resections [4, 5]. With the development of total parenteral nutrition, patients could remain nutritionally intact and undergo additional diagnostic and operative procedures. With time, it was hoped that enhanced intestinal absorption would allow enteral autonomy.

These expectations were based on observations that the absorptive function of the remnant bowel improved following extensive resection. Flint, a staff surgeon at the Johns Hopkins Hospital, quantitated the improvement in the absorption of macronutrients in a series of classic animal studies; he demonstrated in dogs that up to 80% of the small bowel could be removed with long-term survival [6]. Along with the development of intravenous nutrition, an appreciation of many of the mechanisms that enhanced remnant function has aided rehabilitation of these patients in recent years [7]. A large number of patients with short intestinal segments (< 50 cm) are now independent of intravenous feedings based on therapy that enhances absorption [8].

Finally, some patients have such a short bowel segment that the surface area remains limiting despite complete adaptation. To return to a more normal life, intestinal transplantation is necessary; and work in this area is slowly progressing so this procedure may soon become a safe, viable option for selected patients in the coming years.

Haymond reported that in 1935 his operative mortality was 33%, and only 20% of the patients survived 1 year [3]. More recent estimates suggest that at least 70% of patients with the short bowel syndrome now leave the hospital, and almost all of this group are alive at the end of 1 year [9]. Indeed, progress has been made.

This paper reviews the perioperative problems associated with extensive bowel resections in adults and provide guidelines for physicians who care for patients who require rehabilitation and specialized nutritional care following massive intestinal resection. It is hoped that these suggestions improve the quality of life and longevity of patients with the short bowel syndrome.

What Is the Short Bowel Syndrome?

The short bowel syndrome is a symptom complex that occurs following intestinal resection because an inadequate small bowel absorptive surface remains and the usual intake of enteral nutrients cannot support the body mass. Ingested food is malabsorbed, and the associated diarrhea causes an excessive loss of nutrients,

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fluid, and electrolytes from the gastrointestinal tract. If untreated, the patients develop signs and symptoms of chronic dehydration and eventually manifest selective nutrient deficiencies. Alternatively, the patient becomes progressively malnourished. Initially, the short bowel syndrome was defined as loss of 50% or more of the small bowel, especially when the distal ileum was removed along with loss of the ileocecal valve. More recently, it has been defined as the symptom complex that occurs in adults who have less than 200 cm of jejunum-ileum remaining. These definitions do not account for the health of the remaining small bowel; if mucosal disease from Crohn's enteritis or radiation injury is present in the remnant intestine, the actual bowel length may not appropriately reflect the altered physiology that exists.

Because of the problems associated with determining the exact length of the preexisting small bowel, it is best to speak of the remnant bowel in absolute terms (centimeters that remain) rather than relative length (percent) remaining. At the time of operation, the surgeon should measure the length of residual bowel. This measurement begins distal from the ligament of Tritz along the antimesenteric border with minimal tension to the end of the small intestine. If colon is also resected, an approximation of the percent of colon remaining should be recorded as well. The length of residual small intestine and an estimate of the remaining colon are used as the basis on which plan further therapy.

Etiology

In adults the causes of the short bowel syndrome are numerous. The small bowel is mobile and suspended on a mesentery. It is also supplied, in large part, by a single vessel, the superior mesenteric artery, and drained by its single companion vein. Thrombosis or occlusion of these vessels (due to torsion of the bowel on the mesentery) usually results in extensive necrosis of the small bowel and approximately one-half of the colon. Thus in a large percentage of patients with the short bowel syndrome the bowel infarcts following thrombosis or embolization of the superior mesenteric artery or thrombosis of the superior mesenteric or portal vein (the latter event being frequently associated with intraabdominal sepsis). Alternatively, these vessels may be occluded owing to a small bowel volvulus. Occasionally, such occlusion is also observed in adults who have congenital malrotation of the intestinal tract and present later in life with a strangulation-obstruction of the bowel associated with massive intestinal infarction. In addition, one or both of the superior mesenteric vessels may be injured following blunt or penetrating trauma or occasionally following excision of a retroperitoneal tumor.

A second large group of adult patients with the short bowel syndrome are those with Crohn's disease (or, to a lessor extent, radiation enteritis). These individuals have usually undergone repeated intestinal resections and eventually present with the signs and symptoms of the short bowel syndrome. In a large series of individuals with $\leq$ 200 cm of jejunum-ileum, patients with inflammatory bowel disease made up about one-fourth of the study population (Table 1) [7]. Another large contemporary series reported by gastroenterologists included an even larger percentage of patients with Crohn's disease in this category [10]. If a series of patients with much shorter segment of bowel ($\leq$ 50 cm of jejunum-ileum with a portion of colon in continuity) is considered, the patients with mucosal disease proportionally become a much smaller part of this population [8].

Table 1. Cause of the short bowel syndrome in two large series of adults.

Cause	Patients with $\leq$ 200 cm jejunum-ileum (no.)	Patients with $\leq$ 50 cm jejunum-ileum with colon in continuity (no.)
No.	87	45
SMA thrombosis/mesenteric infarction	27 (31%)	20 (44%)
Small bowel volvulus	10 (12%)	6 (13%)
Trauma	7 (8%)	6 (13%)
Crohn's disease	21 (24%)	4 (9%)
Obstructive/adhesion	11 (13%)	4 (9%)
Radiation injury	7 (8%)	1 (2%)
Congenital malrotation	2 (2%)	2 (4%)
Other	2 (2%)	2 (4%)

SMA: superior mesenteric artery.

Disease History

The chronology of the short bowel syndrome can generally be divided into three phases: (1) the initial resection associated with perioperative care; (2) the period associated with initial enteral feeding and bowel compensation (e.g., subacute phase); and (3) the chronic phase characterized by the problems of malabsorption, diarrhea, parenteral nutrition, and chronic nutritional deficiencies.

Perioperative Period

In the case of mesenteric vascular occlusion, the physician is frequently asked to examine a patient with nonspecific abdominal pain associated with bloody diarrhea. The initial episode may resolve and later recur as intermittent bouts of pain, or the symptoms may present as an acute episode that progresses to a catastrophic event. Often the pain is out of proportion to the physical findings, as are the associated leukocytosis and lactic-acidosis. The clinical diagnosis should be suspected in an elderly patient with abdominal pain who is recovering from recent cardiac surgery or suffers from severe arteriosclerosis (or both). Similarly, a pregnant patient with malrotation and abdominal pain may present with bowel infarction at the time the gravid uterus impinges on the intestinal contents causing a fatal twist of the mesentery. Physicians should be highly suspicious of bowel infarction in patients with coagulopathies, and extensive bowel necrosis may also be present following blunt or penetrating trauma. However, many patients 20 to 40 years of age initially present with an infarcted bowel as their only symptom, and this event prompts further diagnostic investigation (usually evaluating coagulopathies) following the initial bowel resection. In contrast to patients who seek medical assistance because of acute abdominal complaints, patients with severe protracted or recurrent inflammatory bowel disease frequently require repeated resection of diseased bowel, eventually resulting in a marginal intestinal remnant and severe diarrhea.

Postoperative complications are common in patients following massive intestinal resection; reexploration and further resection of necrotic bowel is frequently necessary, and the presence of intraabdominal abscesses and fistula is common. Image-guided

Table 2. Planning long-term management in patients with the short bowel syndrome.

	Length of jejunum-ileum (cm)			
	< 50	50–100	101–150	151–200
Colon in continuity	About 50% of this group can be independent of TPN following a bowel rehabilitation program (see Fig. 3 for prediction of success). The remainder require TPN for life or are candidates for intestinal transplantation.	May require short-term TPN (6 months) or can compensate more rapidly with growth factors and nutrients.	Short term TPN occasionally required in the complicated patient.	Should do well with general dietary education and specific nutrient supplements.
No colon (ostomy)	An extremely difficult group of patients to manage who may required TPN for life. If residual bowel is present but not in continuity, consider an operative procedure. Complication rates are high in this group of patients. Nutritional deficits are common along with chronic dehydration and electrolyte imbalance. Patients from this group may be considered for intestinal transplantation.	Some patients in this category may be marginal without intravenous support, especially those with shorter segments and inflammatory bowel disease. Patients who require parenteral support in large part require only intravenous fluid and electrolyte infusions.	Attention to fluid balance is necessary to prevent renal dysfunction/failure.	

TPN: total parenteral nutrition.

drainage procedures and associated diagnostic studies may be necessary before initial recovery is achieved. All normal bowel or even marginally normal bowel should be retained if a major resection is required. A second-look procedure may be appropriate to evaluate the health of the remnant bowel and anastomosis of viable intestine can be performed at that time. If possible, all remaining bowel should be placed in continuity during the initial or a subsequent *early* hospitalization. Placing all intestine in continuity maximizes the exposure of all of the available intestinal surface area to enteral nutrients, enhancing optimal adaptation, maximizing absorption, and minimizing complications.

Shortly before discharge a permanent central venous catheter should be placed. It could be a subclavian Silastic catheter with or without a subcutaneous port or a centrally placed percutaneous catheter inserted via a large peripheral arm vein (PICC line). A percutaneous central venous catheter is used for nutrient administration throughout the hospitalization, which allows easy exchange of this catheter over a guidewire. This practice greatly facilitates the diagnosis and treatment of catheter infections in patients who are prone to developing intraabdominal sepsis. Thus, the appropriate and timely diagnosis of catheter sepsis is facilitated by the ability to remove the central venous catheter easily and culture its tip. All infection sites should be cleared before a permanent line is inserted.

Subacute Period

As the patient recovers from the bowel resection (and its associated complications), a general discussion of the long-term health of the individual is warranted. First, consideration should be given to the age of the patient and the possibility of associated diseases, which greatly affect outcome. (For example, the prognosis is poor in an elderly patient with severe arthroscleratic cardiovascular disease or in an individual with cancer.) If confounding diseases are not present, the general outcome can be discussed based on the length of residual bowel and the anatomy of the remnant intestine (Table 2).

At hospital discharge, the care plan should focus on maintaining safe, adequate nutritional support (including hydration). Once this problem is solved, the patient can be discharged from the acute care facility to a rehabilitation unit or to the home. Two possible approaches are available to achieve this goal: The patient is taught to self-administer total parenteral nutrition (TPN) or the patient can initiate an enteral feeding program (or both). Techniques and approaches to provide safe home TPN have been well standardized; and with the support of a visiting nurse, the patient or family can generally manage this therapy following initial teaching sessions. Often more disabling are enteral feedings; oral food intake is often initially associated with nausea and vomiting and then later with diarrhea. The nausea is best treated by providing frequent small feedings of relatively low-fat foods. On occasion, administration of antinausea drugs is indicated. If food intake is possible, it is almost always related to the high output of watery diarrhea.

Diarrhea is initially prevented by *restricting and controlling food intake.* This program may be initiated in the hospital but is an important part of rehabilitation at the time of patient discharge. The patient is started on a six-feeding diet high in complex carbohydrates (55–60% of energy intake) and protein (20%). Rice, baked potatoes, and pastas balanced with small quantities of chicken, fish, and lean meat serve as the mainstay for this diet. *Intake is initially restricted to 600 kcal/day* to prevent diarrhea. Fluid is provided as an electrolyte-containing drink (Gatorade, The Gatorade Co., Chicago, IL; Pedialyte, Ross Laboratories, Columbus, OH; Ricelyte, Mead Johnson, Evansville, IN, USA) and is restricted to 600 ml/day. With this intake diarrhea should not be extensive, and anal excoriation or incontinence rarely occur. With time (2–6 weeks of oral intake) and tolerance, the quantity of food and fluid ingested can usually be increased to 1000 kcal and 1000 ml/day, respectively. Antiperistaltatic agents

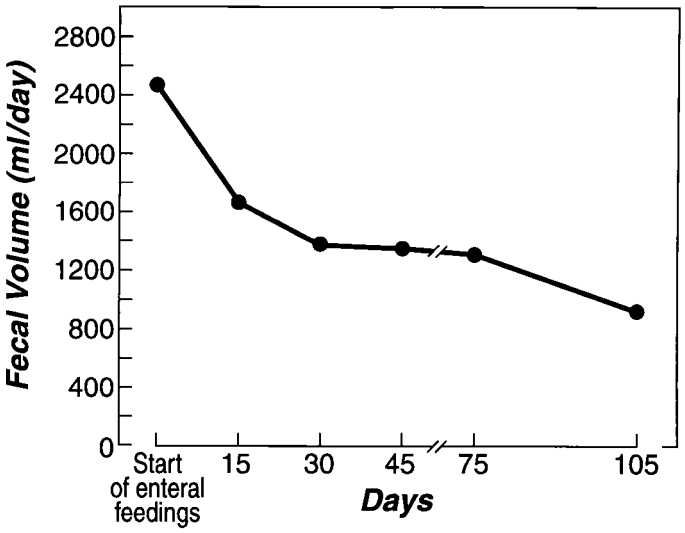

Fig. 1. Fecal volume decreases with time in adult patients with ≥ 80 cm jejunum-ileum. Patients received near-constant or increasing amounts of tube feedings throughout the period of observation. (Adapted from Levy et al. [13], with permission.)

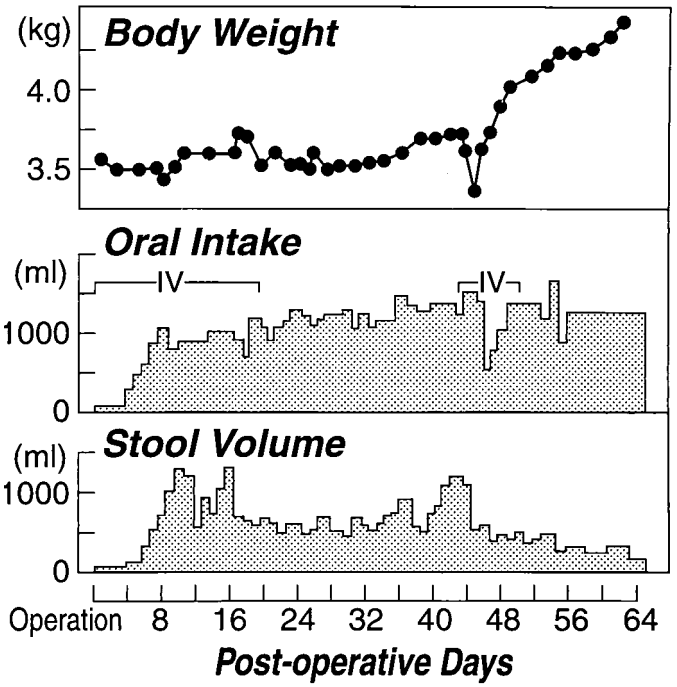

Fig. 2. Adaptation occurs with time in an infant following massive bowel resection for gastroschisis. Oral intake remained relatively constant, as stool output decreased and body weight increased, demonstrating enhanced absorption.

(Lomotil, G.D. Searle, Chicago, IL; or codeine sulfate), taken shortly before meals, may be added to this treatment plan as indicated.

Over a period of weeks or several months, the patient may observe changes in stool frequency and consistency. The quantity of food and fluid provided should then be increased and titrated against bowel output to prevent excessive diarrhea, prolong the transit time, and enhance absorption. This is a gradual process, and the type and quantity of food should be controlled by the physician during this adaptive phase. An enteral nutritional goal is established to provide 120% to 200% of the usual energy and protein requirements; the percentage utilized generally varies inversely with bowel length [11]. This dietary adjustment generally compensates for the malabsorption of macronutrients that occurs.

From the biologic point of view, the most interesting aspect of the process is the intestinal adaptation that occurs during this period and enhances bowel absorption. Studies in dogs related the improved absorption to an increase in intestinal mass. Subsequent studies in other animal models (particularly rodents) have related an increase in villous height and intestinal cellularity with an increase in crypt cell proliferation following resection. Simultaneously, improved absorption of fat, protein, glucose, sodium, water, bile acids, vitamin B_{12}, calcium, and zinc have been observed [12]. Some investigators have reported that disaccharidase and peptidase activities are normal or even reduced following resection, suggesting that cell function may not change or that immature cells may comprise most of the enterocyte population in the hyperplastic mucosa. Others have found that the individual enterocytes have enhanced activity of selected enzymes (e.g., disaccharidase and Na^+K^+-ATPase); these alterations are probably induced by the exposure to increased luminal nutrients.

Although it is well documented that the human small bowel increases its absorptive capacity with time following intestinal resection (Figs. 1, 2), the alterations in morphology are not entirely consistent with those observations in animals. In the human, the bowel dilates and becomes somewhat elongated. Intestinal biopsies do not demonstrate villous hypertrophy but have suggested that altered cell turnover may occur.

In 1965 Porus studied the intestinal morphology of four patients following resection of 50% to 80% of the small bowel and compared the findings with 16 normal controls matched for age and gender [14]. The morphologic approach he used had been carefully validated in animal studies. He concluded that "for the first time, there is quantitative evidence that hypertrophy of villi does not occur in man even after what must be an almost maximal resection compatible with life." Porus, however, did observe that there was increased cellularity on the villi of the two patients with the most extensive resections (e.g., more cells per unit length) and suggested that this may be an attempt to compensate by increasing the number of absorptive sites on the remaining villi. This finding has been confirmed by O'Keefe et al., who found villous height in a group of patients with short bowel to be similar to that observed in health controls: 354 ± 23 vs. 429 ± 5 μm (mean ± SE, patients vs. controls) [15]. Thus in patients the dilated remnant coupled with improved cell transport function and prolonged transit time provides functional adaptation and increased nutrient absorption.

The cause of the intestinal adaptation has been of great scientific interest; and during the past few years the role of hormones, nutrients, and growth factors has been integrated into a general paradigm that explains this response. Intraluminal nutrients maintain the gut mass, and enteral feedings are necessary for the adaptative response to occur. This is clearly demonstrated in animal studies. For example, when normal animals receive all essential nutrients by vein and have no oral intake, mucosal atrophy occurs [16]. Following intestinal resection, orally fed animals undergo intestinal hypertrophy, whereas their intravenously

fed counterparts demonstrate mucosal atrophy [17]. Thus oral intake remains the therapeutic cornerstone, maintaining gut mass and enhancing luminal nutrient absorption.

Chronic Phase

Most patients who reach the chronic phase of their illness realize they will require TPN for a prolonged period of time or will be independent of parenteral support but may require a modified diet and nutritional supplements to avoid nutrient deficiencies (Table 2). If TPN is required, every attempt should be made to encourage *enteral* intake, which optimizes bowel compensation and protects the liver. Because TPN administration suppresses appetite and oral food intake is essential for a successful outcome, this combined enteral-parenteral feeding approach can best be accomplished by providing TPN on three alternate nights each week. This approach may be impossible in patients with high-output ostomies or in those with increased caloric needs, who require daily parenteral infusions to maintain adequate hydration or to provide increased energy. When extra hydration is necessary, electrolyte-containing fluid is provided four times a week, and TPN is infused on a three nights-a-week, alternate-night schedule. Patients with increased energy requirements may require TPN 6 or 7 nights a week for several months. However, such an infusion schedule is only required periodically and then in only a small percentage of short-bowel syndrome patients (approximately 20%).

Long-term Care: Preventing Complications

Because massive intestinal resection represents a chronic condition, it should be approached with the view of *preventing* or reducing *complications.* This is best accomplished by considering the events that are generically related to all patients with the short bowel syndrome and then identifying complications that have a high probability of occurring in a specific patient because of the anatomic portion of intestine that was resected. A detailed review of this approach is presented elsewhere [18], but a summary of this strategy is found on Table 3.

Table 3. Problems and their solutions.

Problem	Solution
Generic problems	
Maintain adequate nutrition	Educate, monitor weight, set goals, keep enteral food and fluid intake records
Prevent selective nutrient deficiencies	Monitor and measure at 3- to 6-month intervals essential fatty acids, vitamins and minerals (Mg, Mn, Zn, Ca). Prescribe oral supplements or add additional nutrients to infusate
Minimize organ failure	Liver: oral intake, antioxidants, possibly choline. Kidney: hydrate, monitor output. Bone: supplemental Ca, Mg, vitamin D (include skin exposure to the sun)
Gastric hypersecretion	Provide hydrogen ion blocking drugs
Cholelithiases	Cholecystectomy
Problems in patients with the colon in continuity	
Renal stones	Hydration; low oxylate diet
Bacterial overgrowth, D-lacticacidosis	Reasonably rare in adults. Do not allow the patient to eat simple sugar. If D-lacticacidosis occurs, hydrate and give antibiotics; consider repopulating the gut with *Lactobacillus*
Problems in patients without colons	
Chronic dehydration	Hydrate, monitor urine output, give IV fluid (not TPN), if necessary
Nutritional deficiencies	Monitor vitamins, minerals, and EFA levels every 3–6 months. Provide supplements; give IV nutrients if necessary
Stomal problems	Symptomatic care

IV: intravenous; EFA: essential fatty acid.

Table 4. Factors demonstrated to enhance enterocyte and/or colonocyte proliferation.

Peptides: epidermal growth factor; transforming growth factor-α; insulin-like growth factors I and II; keratinocyte growth factor; peptide YY; glucagon-like peptide 2; neurotensin; hepatocyte growth factor
Nutritional factors: fiber, short-chain fatty acids, glutamine, triglycerides, polyamines, lectins
Cytokines: interleukins 3, 11, and 15
Other: pancreaticobiliary secretions

Use of Growth Factors and Nutrients to Facilitate Bowel Adaptation

The intestinal mucosa has a high rate of cell turnover and hence is responsive to a variety of growth factors and specific nutrients that enhance proliferation (Table 4). Utilizing these factors may facilitate small bowel adaptation in selected patient groups.

We have evaluated several factors with minimal side effects that are available for use in patients. We performed a variety of studies utilizing growth hormone, the amino acid glutamine, and a specialized diet in a supervised setting for at least 4 weeks. After an initial assessment, growth hormone was administered subcutaneously at doses ranging from 0.03 to 0.14 mg/kg/day (average dose 0.06 mg/kg/day). Supplemental glutamine was provided by the parenteral route to the patients receiving TPN and by the oral route to the malabsorbing patients. The parenteral dose averaged approximately 0.16 g/kg/day; oral glutamine was also administered to these individuals as the TPN was decreased. The oral dose averaged 30 g/day and was administered in divided doses in a cold beverage. A modified diet was provided that was high in complex carbohydrates, low in fat, and moderate in protein.

Approximately 200 adult patients with short bowel syndrome (defined as $<$ 200 cm jejunum-ileum) have been treated with this approach to date, and an interim report of the results has been published [19]. After 1 month of treatment in an assisted living facility, the patients were returned home on only the modified diet and oral glutamine.

At the end of the 1-month treatment program, 52% of the patients were independent of TPN, 38% had reduced TPN requirements, and only 10% required the same quantity of TPN support. At follow-up (an average of 1.3 years for treatment), 41% of the group remained off TPN, 37% had reduced TPN requirements, and 22% remained on the same level of infusion.

In an additional study, 45 TPN-dependent adults with a jeju-

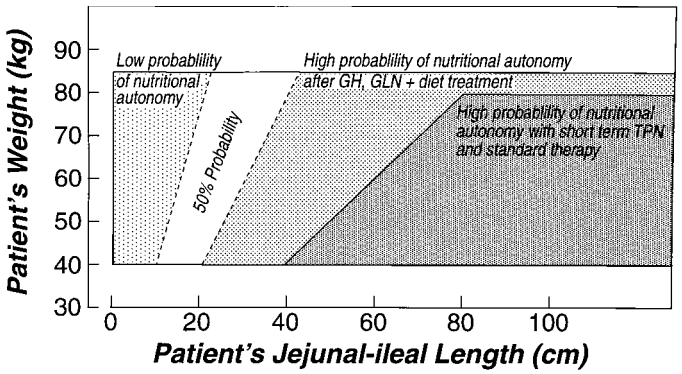

Fig. 3. Chart used to predict the probability of success of weaning a short bowel patient with a portion of colon in continuity from total parenteral nutrition (TPN). To determine the predicted outcome for an individual patient, locate the point at which bowel length and body weight cross. The identified area describes the predicted outcome. GH: growth hormone; GLN: glutamine.

num-ileal remnant < 50 cm and a portion of colon in continuity were treated in this same manner and followed for an average of 1.8 years [8]. After 4 weeks of therapy, 26 (58%) were free of TPN support. Predictors of a favorable response included greater bowel length, decreased body weight, and higher bowel length/body weight ratio. The latter value could be used as a predictor of the success of this therapy (Figure 3). Now about 50% of patients in this group thought to be dependent on TPN for life can be free of parenteral therapy.

Intestinal Transplantation

For patients unable to compensate and adapt following intestinal resection, with the only method of care long-term TPN, intestinal transplantation seems a reasonable, desirable alternative treatment. Unfortunately, technical and immunologic problems remain formidible with this procedure, and costs and mortality rates remain high.

The largest group of patients reported to date have undergone operations at multiple centers, and their outcomes are collated in a transplant registry [20]. Such reports represent the results of multiple operative and immunosuppressive protocols; in addition, there is little standardization of patient age or disease.

Of the 180 transplantations reported in 170 patients, two-thirds of the recipients were children; 64% of the total group were given the transplants because of a previous massive bowel resection. In 62% of the patients, multivisceral grafts were performed, with intestine plus liver predominating. Graft failure at 2 years was 40%, and long-term outcome appeared slightly better for the combined grafts than for intestine alone. Patient survival was only slightly better than graft survival.

One of the unexpected problems in this patient group was the growing incidence of lymphomas that occurs with time. This is thought to be related to the use of high doses of immunosuppressive drugs. Lowering the dosage increases the possibility of graft rejection or the development of graft-versus-host disease (or both). Modifications of the immunosuppressive protocol are now being evaluated, including the effects of combined bone marrow–intestine transplantation. It is anticipated that when the problems related to the immunosuppressive therapy can be resolved this procedure will provide another long-term treatment modality for patients with intestinal insufficiency.

Résumé

Le syndrome de l'intestin court est un ensemble de symptômes complexes qui se voit chez l'adulte ayant moins de 200 cm de jéjunum iléum restant après une résection intestinale. Des symptômes similaires peuvent être observés chez l'enfant après des résections intestinales massives ou chez un individu ayant un segment d'intestin plus long mais dont la muqueuse intestinale est malade. Les soins du début sont bien entendu l'excision complète de tout segment intestinal non viable, une évaluation exacte de la longueur viable, la mise en continuité de l'intestin dans les interventions chirurgicales planifiées et une alimentation réglée. Avec le temps, l'intestin restant s'adapte et la fonction d'absorption pourrait être maximalisée par un régime entéral dit «amélioré» alors qu'elle est minimalisée par une nutrition parentérale. Les facteurs de croissance et des nutriments spécialisés peuvent aussi améliorer ce procédé. La transplantation intestinale doit être envisagée chez des patients ayant un intestin court qui échouent aux protocoles de rééducation intestinale.

Resumen

El síndrome de intestino corto es un cuadro clínico de compleja sintomatología complejo que aparece en aquellos adultos que quedan con < 200 cm de yeyuno-íleo luego de una resección intestinal. Síntomas similares han sido observados en lactantes y en niños luego de resecciones intestinales masivas o con anomalías congénitas y en individuos con segmentos más largos de intestino pero afectado por enfermedad mucosal severa. El manejo inicial de pacientes con isquemia mesentérica se enfoca hacia la resección completa del intestino no viable, la medición exacta del intestino viable remanente, el restablecimiento de la continuidad intestinal durante la operación inicial o en un segundo tiempo, y el control de la ingestión inicial de alimentos. Con el tiempo se produce adaptación del intestino remanente, cuya capacidad de absorción puede ser mejorada incrementando la dieta enteral y minimizando la nutrición parenteral. Los factores de crecimiento y determinados nutrientes específicos también aceleran el proceso. Se debe considerar el trasplante de intestino en casos seleccionados de intestino corto que no mejoran con los protocolos de rehabilitación intestinal. Cause of the short bowel syndrome in two large series of adults. Planning long-term management in patients with the short bowel syndrome. Problems and their solutions. Factors demonstrated to enhance enterocyte and/or colonocyte proliferation.

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