

Nutritional Considerations in Inflammatory Bowel Disease

by Kelly Anne Eiden, M.S., R.D., CNSD

Nutrient alterations are commonplace in patients with inflammatory bowel disease. The etiology for these alterations is multifactorial. Nutrition assessment is the first step in successful nutrition management of any patient with gastrointestinal disease. Nutritional goals include assisting with nutrition risk, identifying macronutrient and micronutrient needs and implementing a nutrition plan to meet those needs. This article addresses many of the nutrition issues currently facing clinicians including: oral, enteral and parenteral nutrition, common vitamin/mineral deficiencies, medium chain triglycerides and nutrition as primary and supportive therapy.

INTRODUCTION

Inflammatory bowel disease (IBD), encompassing both Crohn's disease and ulcerative colitis (UC), is a chronic inflammatory intestinal disorder of unknown etiology. A multitude of factors, including drug-nutrient interactions, disease location, symptoms, and dietary restrictions can lead to protein energy malnutrition and specific nutritional deficiencies. It is estimated that up to 85% of hospitalized IBD patients have protein energy malnutrition, based on abnormal anthropometric and biochemical parameters (1,2). As Crohn's disease can occur anywhere from mouth to anus (80% of cases in the terminal ileum), it is associated with greater nutritional insult than UC, which involves only the colon and rectum. Medical nutrition therapy has been proposed as both a primary

and supportive treatment in both Crohn's and UC. The following article will provide guidelines to help the clinician determine nutritional risk, review specialized nutrient needs and discuss nutrition as a treatment modality in the patient with IBD.

NUTRITION ASSESSMENT IN INFLAMMATORY BOWEL DISEASE

Factors Affecting Nutritional Status in the Patient with IBD

There are many factors that alter nutrient intake in the patient with IBD. Nutrition abnormalities can be a result of malabsorption, decreased food intake, medications and/or intestinal losses. These deficiencies will differ between individual patients depending on the location of disease activity and specific nutrient absorption found at these sites. For a list of factors precipitating nutritional demise in patients with IBD, see Table 1.

Kelly Anne Eiden, M.S., R.D., CNSD, Nutrition Support Specialist, Barnes-Jewish Hospital, St. Louis, MO.

Table 1
Factors Altering Nutritional Status in Patients with IBD

- Decreased nutrient intake
 - Anorexia
 - Fear of eating
- Nausea, vomiting, abdominal pain, diarrhea
- Restrictive diets
- Side effects of medications
- Appetite suppression, taste changes
- Oral aphthous ulcerations
- Protein losses from inflamed, ulcerated mucosal
- Increased needs for healing
- Surgical resections
- Increased vitamin and mineral needs
- Bacterial overgrowth
- Malabsorption
- Blood loss

No single indicator is available to determine an individual's nutritional status; assessment requires a nutritional history, physical exam, objective laboratory parameters and clinical judgment. Subjective global assessment (SGA), developed originally for use in oncology patients, is a useful tool for screening an IBD patient. Using SGA, patients are categorized into one of three stages: well nourished, moderately malnourished or severely malnourished. SGA takes into

account history of weight change, food intake, gastrointestinal (GI) symptoms and functional capacity. SGA, coupled with physical exam, provides clinicians with an indication of the patients nutrition risk and need for intervention. SGA has been shown to provide reproducible results with greater than 80% agreement (3). Table 2 gives an example of how SGA can be adapted and used for an IBD patient.

Further evaluation of nutrition risk can involve the use of body mass index (BMI). However, one measured weight cannot provide a thorough picture of risk. In addition, a normal appearing BMI does not necessarily correlate with an adequately nourished patient. One has to establish if the weight has significantly changed, over what period of time and if weight loss was intentional or not. A very low BMI or significant change in BMI requires more immediate nutrition intervention.

Clinicians often use albumin as a marker of nutritional status. However, in the case of a hospitalized or sick patient, a low albumin reflects an acute or chronic inflammatory process such as infection, trauma or cancer. The IBD patient often falls into this category. During the inflammatory process, albumin synthesis is decreased, degradation is increased and transcapillary losses from the plasma compartment are increased. IBD patients often have losses from their GI tract that can also

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Table 2
Subjective Global Assessment In the IBD Patient

<i>Criteria</i>	<i>Well Nourished</i>	<i>Moderately Malnourished</i>	<i>Severely Malnourished</i>
Unintentional weight loss (last 6 months)	Loss < 5%	Loss 5–10%	Loss > 10%
Dietary intake	Meets needs	70–90% of needs	< 70% of needs
Gastrointestinal symptoms (anorexia, nausea, vomiting, diarrhea, taste change)	No symptoms	Intermittent	Daily
Functional capacity	Normal	Reduced	Bedridden
Disease type	Remission	Smoldering	Acute

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Table 3
Suggested energy requirements for patients based on Body Mass Index (BMI)

BMI (kg/m ²)	Energy Requirements (kcal * kg ⁻¹ * d ⁻¹)
< 15	36–45
15–19	31–35
20–29	26–30
> 30	15–25

Note: The lower range within each category should be considered in a critically ill patient, unless he or she is depleted in body fat, to decrease the risk of hyperglycemia and infection associated with overfeeding.

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impact serum levels. A serum albumin should not guide the clinician in the decision to initiate nutrition support. Although many patients with low albumin have poor nutritional intake, it is unlikely that this is responsible for their low albumin levels. Albumin levels reflect the metabolic response to stress and therefore will not normalize in these patients until the inflammatory process is corrected, despite adequate nutrition support (4). Conversely, a normal albumin level in a patient without intake for an extended period of time, does not always correlate with adequate nutritional stores as demonstrated in the case of patients with anorexia nervosa.

MACRONUTRIENT REQUIREMENTS IN INFLAMMATORY BOWEL DISEASE CALORIES

Calories

There are many equations available to estimate energy requirements, however, validation with clinical outcome is still wanting. Recent studies have shown resting energy requirements are not increased in patients with Crohn's disease (5). BMI can be used for estimating caloric requirements although needs must be reassessed over time (Table 3). The use of BMI to calculate energy needs is based on the theory that the lower the BMI, the less adipose, more lean, metabolically active tissue present. Caloric requirements are

higher per kilogram body weight in patients with lower BMI's. However, some patients with a high BMI are very active and possess greater amounts of lean tissue (i.e., weight lifters). A word of caution however, any patient with a significant weight loss should be started on a refeeding calorie level (20–25 kcal/kg) and monitored before advancing to a higher calorie goal.

Protein

Patients with IBD may have increased protein needs due to losses from inflammation of the intestinal tract, catabolism when an infection is present (i.e. abscess) and possibly for healing if patient requires surgery. Protein needs are assessed based on disease status and body weight. The recommended daily allowance (RDA) for protein is 0.8g/kg actual weight. The majority of IBD patients free from renal disease require approximately 1.0–1.5g/kg body weight. Protein may need to be restricted in renal failure patients who are not receiving dialysis. Patients on either hemodialysis or peritoneal dialysis require 1.2–1.5g/kg body weight to meet needs and to replace the protein lost in the dialysate. Ideal body weight can be used to prevent provision of excess protein to patients who are obese.

VITAMIN AND MINERAL ISSUES IN INFLAMMATORY BOWEL DISEASE

Vitamin and mineral deficiencies in IBD have been well documented (1). Although serum levels of some nutrients may be reported as low, interpretation of these findings and consequent treatment guidelines are not well established. There are no gold standards for measurement in clinical practice for many of these nutrients. Table 4 provides information on signs and symptoms of vitamin/mineral deficiencies commonly found in the patient with IBD based on clinical practice and research available. Treatment recommendations that may correct deficiency states are also listed.

VITAMINS

Vitamin B₁₂

Vitamin B₁₂ status can be altered in those patients who have had surgical resections of the stomach (intrinsic

Table 4
Vitamin and mineral requirements and assessment and treatment of deficiencies (1–3,16,19)

<i>Nutrient</i>	<i>Recommended daily requirements</i>	<i>Signs or symptoms of a deficiency</i>	<i>Recommended replacement for deficiency (oral dose)*</i>
Zinc	15 mg	Dry, flaky skin, peeling palms, diarrhea, mental status changes	50 mg elemental/day
Iron	10–15 mg	Microcytic anemia, fatigue	300 mg 1–3/day
B ₁₂ (cobalamin)	3 mcg	Megaloblastic anemia, paresthesias, ataxia, diarrhea, mental status changes	1000 mcg/day
Folate	400 mcg	Sore mouth, glossitis, diarrhea, forgetfulness, megaloblastic anemia	1 mg/day
Calcium	800–1500 mg	Osteopenia, osteoporosis, tetany	1500–2000 mg/day
Magnesium	400 mg	Nausea, muscle weakness, arrhythmia's, confusion, seizures	150 mg elemental Mg 4x/day
Vitamin D	400 IU	Rickets, osteomalacia, bone pain, muscle weakness, tetany	Variable (see text)

*Amounts are general guidelines and should be adjusted based on individuals needs with ongoing assessment as to the cause (i.e. malabsorption)

factor production) and/or the terminal ileum (site of absorption). Although intra-muscular (IM) replacement is the treatment of choice for most clinicians, oral supplementation is possible with higher doses of synthetic B₁₂ (6). A nasal gel is also now available (Nascobal®) that can be used in place of monthly IM injections. Cost differences between oral, IM and nasal doses are found in Table 5.

Serum methylmalonic acid (S-MMA) is a more sensitive indicator of cobalamin deficiency than serum vitamin B₁₂. Elevated concentrations of S-MMA represent a metabolic change that is very specific to B₁₂ deficiency making it the preferred indicator of B₁₂ status (7). Homocysteine is also an indication of pending B₁₂ deficiency, unfortunately, it is also affected by B₆ and folate status, is commonly elevated in the elderly, and therefore, it has poor specificity to serum B₁₂.

There are four stages of B₁₂ deficiency. In stage I and II, plasma and cell stores become depleted. Increased levels of S-MMA and homocysteine are found in stage III with clinical signs becoming apparent in stage IV (macrocytosis, increased mean-corpuscular volume (MCV) and decreased hemoglobin). Studies have shown 60% of vegetarians have stage III defi-

Table 5
Cost Comparison of Vitamin B₁₂ Supplements

<i>B₁₂ Formulation</i>	<i># Doses per Month</i>	<i>Average Cost Per Month*</i>
Intranasal Nascobal® www.nastech.com/nasocobal (888) 514-5208	4	\$34.80 (500 mcg dose)
IM injection (Does not include cost of syringes)	1	\$0.79 (1000 mcg dose)
Capsule	30	\$0.76 (1000 mcg dose)

*Wal-Mart March 2003

ciency (8) with recommendations to monitor B₁₂ status in this group of patients closely. Use of S-MMA for general practice diagnosis of B₁₂ deficiency may promote over treatment with B₁₂ (9) and may not be readily available at most laboratories. Use of S-MMA as a screening tool would not be recommended, although may be worthwhile in high-risk populations. S-MMA is strongly associated with serum creatinine levels, yet it is unclear the extent to which the increased levels are attributed to impaired renal function versus impaired cobalamin metabolism (10).

Folate

Some medications used to treat IBD, such as methotrexate, a folate antagonist, and sulphasalazine, which blocks folate absorption, increase folate requirements. Good sources of folate (i.e. green leafy vegetables, legumes) can be difficult to tolerate for some IBD patients and therefore a supplement may be beneficial. The best indicator of folate status is red blood cell folate as it is only taken up by the developing erythrocyte in the bone marrow (11). In patients on routine folate supplementation, beware of a potentially masked B₁₂ deficiency and monitor periodically. Folate supplementation may also be protective against colon cancer (12).

An increased homocysteine level has been identified as a risk factor for thrombosis, arteriosclerotic cardiovascular disease and stroke. Research has found hyperhomocysteinemia to be significantly more common in IBD compared to healthy controls and is associated with lower levels (but not necessarily deficiency states) of vitamin B₁₂ and folate (13,14).

Calcium and Vitamin D

Long-term steroid use leads to accelerated bone loss with resultant osteopenia or osteoporosis. A decreased intake of dairy foods as a result of lactose-restricted diets can further that loss without attention to calcium and vitamin D status. Patients with IBD have a reduction in bone mineral density that is multifactorial in nature. Risk factors include: corticosteroids, vitamin D deficiency, malabsorption, malnutrition, hypogonadism, and systemic inflammation (15). Of note, in

IBD, continuous, higher dose (>7.5 mg/d) corticosteroids as compared to alternate day and lower dose treatment have been associated with a greater loss in bone mineral density (1). Dual energy x-ray absorptiometry (DEXA scan) is recommended to evaluate bone density. Assessment of adequate calcium and vitamin D intake is important in all patients with IBD with supplementation if the diet is found deficient. One tablet of Oscal® 500 plus vitamin D given 2 to 3 times per day can meet requirements providing 1000-1500mg calcium and 400-600 IU of vitamin D. Patients with osteoporosis may need more aggressive therapy with a biphosphonate agent. For more information on calcium and vitamin D supplements, see February 2003 *Practical Gastroenterology* article on lactose intolerance.

There is evidence that “prednisone induces a state of vitamin D resistance” (3) which increases parathyroid hormone levels and calcium losses. Patients may need a higher dose of vitamin D to inhibit this process with up to 50,000 IU every 2-4 weeks, although large amounts of vitamin D are not recommended for long-term use in patients with a functional GI tract (2, 3, 16). In patients with severe malabsorption 2,000-4,000 IU of vitamin D per day may be needed to achieve normal serum 25-hydroxyvitamin D levels (3, 16). In general, the daily requirement of 400 IU per day would be recommended for the IBD patient at risk for deficiency.

MINERALS

Zinc

In both UC and Crohn's disease, patients can have excessive stool losses or develop high output fistulas that may require supplemental zinc. It has been estimated that up to 15 mg can be lost per liter of stool output (3). There is no gold standard applicable in clinical practice for the measurement of zinc status. The majority of research has shown decreased serum levels in Crohn's patients versus controls though no actual symptoms of deficiency were detected. This can be referred to as an “apparent” zinc deficiency meaning other things such as inflammatory stress or low albumin levels (zinc is transported in part by albumin) are responsible for low serum levels (17). At our institu-

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tion, there have been cases of patients with short gut developing clinical signs of deficiency exhibiting peeling of palms and soles of feet with resolution of symptoms with the addition of extra intravenous zinc (up to 15 mg per day) provided in total parenteral nutrition.

Iron

Blood losses, more prevalent in UC, can lead to iron deficiency anemia. This can be difficult to correct with diet alone. Iron supplements and iron rich foods may have enhanced absorption when a source of vitamin C is ingested at the same time. Although larger doses are often used, only 25–50 mg of vitamin C is necessary to increase iron bioavailability. This can be achieved by taking iron with 2-3 ounces of a vitamin C containing beverage or a portion of the standard 250 mg vitamin C tablet.

Magnesium

Magnesium can be a concern especially with patients experiencing increased intestinal losses as is the case in many IBD patients, especially those with short bowel syndrome. A recent study found a correlation between a low serum magnesium and risk for lower bone mass density (18).

Magnesium can be repleted via the enteral or parenteral route. The pH of the stomach to ileum, GI transit time and the fat content of a meal can effect the degree of intestinal magnesium absorption. Supplementation with large amounts of enteral magnesium may cause diarrhea, especially if given over a short period of time. Although magnesium oxide and magnesium hydroxide have a greater percentage of magnesium per tablet than magnesium gluconate (60%, 41% and 5.4% respectively), magnesium gluconate has a higher degree of solubility, making it a better choice for intestinal supplementation.

MEDICATIONS

Medications used in the management and treatment of IBD may have several nutritional implications. Steroids, commonly used in IBD patients, can lead to bone disorders as discussed above and may also lead to diabetes.

Important GI side effects of Flagyl include decreased appetite, metallic taste and dyspepsia. Cholestyramine can bind fat-soluble vitamins (A, D, E and K) as well as interfere with folate and magnesium absorption.

Given the many reasons for nutrient deficiencies in IBD, in our institution, patients are advised to take a multivitamin/mineral complex daily. There are, however, no controlled trials to support this practice. Forvia®, a product formulated and marketed for the patient with IBD is available via the Internet. This product contains water-miscible forms of fat-soluble vitamins with increased amounts of vitamin D, vitamin K, vitamin E, vitamin B₁₂ and zinc. Forvia® does not contain magnesium due to its potential cathartic side effect. A multivitamin supplement or prenatal vitamin will meet the needs of most IBD patients and are less expensive than specialized formulations. If a patient has significant fat malabsorption water-miscible fat-soluble vitamin formulations, such as ADEK® or Forvia® may be beneficial, however, there are no clinical trials demonstrating superiority over standard formulations in this patient population. Cost comparison and differences between several formulations are reviewed in Table 6.

ORAL DIETS IN INFLAMMATORY BOWEL DISEASE

To date, no special diet has been found to be efficacious in the treatment of IBD. Patients with IBD should be encouraged to follow a normal, healthy diet as tolerated. In some patients, however, the diet may need to be tailored to meet individual needs during the course of treatment based on symptoms and patient preferences. Smaller, frequent meals and use of oral liquid supplements can also be used. Juice based products such as Boost Breeze® (www.meadjohnson.com) and Enlive® (www.ross.com) are new to the market. Formulas developed and marketed for use during Crohn's or UC flares are often elemental or semi-elemental and have low compliance rates due to cost, taste, smell and texture. Examples of some of these products are found in Table 7 in the enteral section. Consultation with a dietitian is beneficial for developing a nutrition plan. If patients cannot meet their needs with oral diets alone, enteral tube feeding supplementation can be considered.

Table 6
Cost and content comparison of vitamin/mineral preparations used with patients with IBD

<i>Vitamin/Mineral Formulation</i>	<i>Significant Composition Differences</i>	<i>Cost average per dose</i>
Forvia® www.forvia.com (866) 619-7705	Increased: Vitamin D (800 IU) Vitamin E (150 IU) Vitamin K (80 mcg) Vitamin B12 (1000 mcg) Zinc (22.5 mg) Iron (30 mg) Does not contain magnesium Contains water-miscible form of all fat soluble vitamins	66¢ (Dose is considered two tablets)
ADEK® www.axcanscandipharm.com	Contains water-miscible form of all fat soluble vitamins Does not contain calcium, iron or magnesium Lower: Folate (200 mcg) Increased: Vitamin E (150 IU)	36¢
Prenatal Formulation	Increased: Folate (800–1000 mcg) Iron (15–30 mg)	10¢
General MVI with minerals (Centrum®)	All vitamins and minerals present May have added herbs or nutraceuticals (i.e. lycopene) added	7¢
Flintstones®	No calcium or iron in original	11¢

Fiber

Low (and occasionally high) fiber diets are frequently recommended in patients with IBD, although prospective randomized studies have not shown a clear benefit. Low fiber diets can limit short chain fatty acids, the preferred fuel for the colonocyte. There is often confusion with regard to the difference between low fiber and low residue diets. Low residue diets limit fiber as well as any other food known to leave a residue in the GI tract (such as milk products, prune juice, etc). Low fiber diets may be beneficial for several conditions (i.e. strictures, diverticulitis), not so for a low residue diet. No difference in complications was seen between a low residue diet (defined as exclusion of legumes, whole grains, nuts, all fruits and vegetables with the exception of ripe bananas and skinned potatoes) and a regular diet in Crohn's patients (20). "Diet as tolerated" is still the mainstay recommended to patients with IBD.

Lactose

Milk intolerance in IBD patients is estimated to be between 10% and 20% (21). However, these studies did not take into account ethnicity. The prevalence of lactose intolerance in UC is no different than the normal population (21,22). Evidence suggests a higher prevalence of lactose intolerance beyond ethnic predictions in Crohn's patients relating to the disease location (21)

Lactose restrictions should only be employed in patients exhibiting symptoms of cramping pain, gas and diarrhea after consuming dairy products. This may be difficult to distinguish in patients with active IBD, however, a trial of a lactose restricted diet with lactase and calcium supplements may be worthwhile. Lactose-free milk can contain up to 50% of daily requirements for calcium per serving compared to 30% of needs in regular milk. As lactose intolerance is dose-dependent,

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most patients can tolerate up to one cup of milk with a meal without the need for lactase supplementation (21).

Strictures/Luminal Narrowing/Ostomies

In IBD patients with strictures it may be prudent to avoid high fiber; nuts, seeds, mushrooms, popcorn, celery and fruit/vegetable skins. It is especially important that patients chew their foods well if strictures are present. Finally, some patients may need to rely on liquids as the sole source of nutrition if strictures or narrowing do not allow passage of normal foods.

At our institution patients with new ileostomies are instructed to avoid the high fiber foods listed above for a period of 2–4 weeks to allow post-op swelling to subside. Fiber-containing foods are added back slowly beginning with water-soluble fibers (oatmeal, bananas, rice and applesauce) followed by insoluble fibers (wheat, bran, corn or nuts) as tolerated. There is no data available to support this practice, however. Patients' ostomies frequently report undigested food in their effluent. Although this may be distressing to patients, from a clinical standpoint, no negative outcomes have been reported. Finally, the following categories are *reported* (based primarily on surveys) to be associated with an increase in odor, effluent or gas respectively:

Odor: onions, eggs, fish, cabbage/cabbage family, legumes, cheese

Increased effluent: Tokay grapes, dried fruits, baked beans, fresh peaches and strawberries, prune juice, coconut, nuts, seeds or kernels, cabbage, celery, bamboo shoots, corn, lettuce, milk

Gas: carbonated drinks, legumes, cabbage, onions, broccoli, cucumber, spinach

Patients with ileostomies may require additional fluid and sodium in order to maintain a urine output > 1200 mL/day. This is especially important to those living in hotter climates or in the summer months. The nutritional challenges presented by the patient with short bowel syndrome will be addressed in a future article in this series.

Medium Chain Triglycerides

Medium chain triglycerides (MCT) are often suggested for use in patients with fat malabsorption.

Unfortunately, they are quite expensive and are not well received by patients in general. It may be more palatable (and less expensive) to incorporate MCT in the form of an MCT-containing liquid supplement vs MCT oil alone. It is also important when using MCT oils not to exceed the threshold dose for patients with ileitis or an extensive resection of the small intestine, as osmotic diarrhea may be a result. A dose of MCT oil up to 50 g/day (8 tablespoons) can be introduced in small amounts over the course of the day with meals. Ingestion of large amounts of MCT oil will further decrease the absorption of long chain triglycerides (23). Of note, because MCT only include fats with carbon chains of C10 or less, they do not contain essential fatty acids. Appendix 1 contains a product list and cost comparison of some of the MCT oils and MCT-containing products on the market. The MCT-containing products listed can be mixed with sorbets or sherbets to further increase calories and improve palatability.

NUTRITION SUPPORT IN INFLAMMATORY BOWEL DISEASE

Enteral Nutrition

The use of enteral nutrition support in treating IBD has been evaluated in many prospective randomized controlled trials (19,23–25). Studies to date have shown steroid therapy to be more effective in obtaining remission than enteral nutrition in patients with Crohn's disease. No difference has been observed between elemental (nitrogen in the form of free amino acids), oligomeric (nitrogen in the form of peptides or protein hydrolyzates) or polymeric (nitrogen in the form of whole proteins) formulas (19,25). Table 7 provides a cost comparison of some of the elemental/oligomeric formulations marketed for IBD versus isotonic, polymeric formulas. Further studies are needed to determine whether specialized nutritional therapy may be helpful in preventing relapse of disease and decreasing steroid requirements in drug-dependent patients. Enteral nutrition support with a polymeric formula should be attempted prior to PN when an oral diet is not tolerated.

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Table 7
Cost Comparison of Enteral Nutrition Products

<i>Product</i>	<i>Kcal/cc</i>	<i>Description</i>	<i>Cost per 1000 Kcal *</i>	<i>Manufacturer**</i>
Standard Polymeric Products				
Osmolite®	1.0	Polymeric	\$ 7.20	Ross Laboratory
Nutren 1.5, Unflavored	1.5	Polymeric	\$3.72	Nestle
Promote®	1.0	Polymeric	\$7.70	Ross Laboratory
Elemental or Semi-elemental Products				
AlitraQ	1.0	Elemental/Powder form	\$30.00	Ross
Criticare HN	1.0	Elemental	\$27.00	Mead Johnson
Modulen IBD®	1.0	Elemental/Powder form	\$8.00	Nestle
Optimental®	1.0	Elemental/Omega 3 fatty acids	\$25.40	Ross Laboratory
Peptamen®	1.0	Oligomeric	\$25.06	Nestle
Subdue®	1.0	Oligomeric/High antioxidant	\$19.79	Mead-Johnson
Vital HN	1.0	Partially hydrolyzed/Powder form	\$21.18	Ross
Vivonex®TEN	1.0	Elemental/Very low fat/Powder form	\$18.33	Novartis
*Cost based on home delivery fees including shipping and handling for March 2003				
<i>Manufacturer**</i>	<i>Phone Number</i>	<i>Website</i>		
Mead-Johnson	(800) 831-3959	www.meadjohnson.com		
Nestle	(800) 776-5446	www.nestleclinicalnutrition.com		
Novartis	(800) 466-6380	www.novartisnutrition.com		
Ross Laboratory	(800) 544-7495	www.ross.com		

Parenteral Nutrition

Parenteral nutrition (PN) can provide nutrition to patients with active disease who meet one of the following criteria:

- Cannot tolerate adequate enteral feedings
- Obstruction and/or stricture present
- Distal fistula with inability to feed beyond site
- Severe short bowel syndrome (approximately less than 150 cm of small bowel remaining)

Use of PN has not been found to be effective as primary therapy in Crohn's or UC (26). The use of perioperative PN has not been carefully studied in IBD and may be used for severely malnourished patients who meet the above criteria. Additional studies are needed to determine the precise role of perioperative PN in patients with IBD.

NUTRITION AS SUPPORTIVE THERAPY IN INFLAMMATORY BOWEL DISEASE

Short Chain Fatty Acids

Short chain fatty acids (SCFAs) are byproducts of bacterial fermentation of undigested carbohydrates in the colon. In humans, acetate, butyrate and propionate are the predominant SCFAs providing up to 600 calories per day to the colonocyte (providing 70% of the energy needs to the colon). Factors that interfere in SCFA oxidation by the colon can weaken the epithelium. Patients with active UC have been found to have a decreased colonic oxidation of butyrate that normalizes when remission is achieved. This has led to the study and development of SCFA enemas. Results using these enemas have shown some benefit in reducing colitis (1).

SCFAs may also be effective in treating antibiotic induced diarrhea due to their participation in regulating water and electrolyte absorption in the colon.

Glutamine

Glutamine has been studied in the treatment of IBD due to its role as a fuel for rapidly replicating cells such as those lining the intestinal tract mucosa. In animal studies, glutamine has been found to improve gut mucosa and decrease damage after certain drug treatments. There is no evidence to date that glutamine has a role in the therapy for IBD (19).

Omega-3 Fatty Acids

Omega-3 fatty acids, found in fish oil, have been studied due to their anti-inflammatory properties. A decreased rate of relapse from remission has been shown in Crohn's disease, although similar results have not been demonstrated in UC (1). This may be due in part to the poor tolerance of fish oil supplements leading to non-compliance. In addition, commercial varieties vary in their composition and may require several pills to achieve the desired dose used in studies to be effective. Side effects can include stomach upset.

PREBIOTICS AND PROBIOTICS

The use of prebiotics and probiotics may prove to be beneficial in certain diseases, including IBD. Prebiotics are nondigestible food ingredients that can beneficially affect the host by selectively stimulating the growth and/or activity of a limited number of bacteria (27). Probiotics are viable microbial food ingredients that confer a benefit to the health of the host (27).

Prebiotics

Examples of prebiotics are fructooligosaccharides (FOS), inulin, lactulose and galactooligosaccharides. Food sources include onions, garlic, asparagus, leeks, bananas, artichokes and chicory root. Enteral tube feeding products containing FOS and inulin are now available (such as Peptamen® with FOS/Inulin, Jevity Plus® and Nepro®). Prebiotics are water soluble, fer-

mentable nonviscous fiber-like substances that exhibit a positive effect on intestinal transit in constipated patients. They act as fecal bulking agents due in part to their osmotic effect. Small amounts are recommended throughout the day due to this effect. Studies have shown that greater than 10 grams per day can cause increased diarrhea and cramping (28). Enteral tube feeding products on the market contain approximately 4 to 8 grams per 1,000 calories. Studies have used anywhere between 3 and 20 grams per day. Prebiotics are currently used to treat encephalopathy; animal studies suggest a decreased risk of colon cancer.

Probiotics

Probiotics are currently being studied at many institutions. The most widely used are *Lactobacillus* and *Bifidobacterium*. Probiotic use has been shown to decrease the frequency and duration of antibiotic associated diarrhea, rotavirus, *C-difficile* and traveler's diarrhea (29). Eight randomized controlled trials have been completed with probiotics and IBD. Five of the trials, all involving Crohn's or pouchitis cases, showed a significantly smaller percentage of relapses with probiotic therapy compared to the control group who received a placebo or 5ASA treatment. The three trials involving patients with UC found no significant difference in relapses, although two of the trials concluded probiotic therapy with *E. coli* Nissle 1917 was equivalent to 5ASA in maintaining remission (29–31).

Food products that are considered probiotics include fermented milk or pourable yogurt and yogurt with live cultures. Many commercial supplements, such as Lactinex®, are available. Neither the FDA nor any federal agency routinely tests for quality of probiotics. Independent tests have revealed up to 30% of probiotics on the market lacked enough active bacteria. Products should reveal the "Live Active Cultures" seal with 10⁸ viable lactic acid bacteria per gram or 10⁷ for yogurt.

Although both prebiotics and probiotics show much potential, more research is needed to determine efficacy, recommended use and dosing for the patient with IBD. One concern voiced against the uncontrolled use of probiotics is that of creating "super bugs" in an era of multiple antibiotic resistant bacteria.

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Table 8
IBD and Related Resources

- Crohn's and Colitis Foundation of America: www.ccfaf.org or 800/343-3637
- HealingWell.com: www.healingwell.com/ibd/
- IBD: <http://www.foundhealth.com/Health/ConditionsandDiseases/I/InflammatoryBowelDisease/>
- National Digestive Disease Clearinghouse: www.niddk.nih.gov/health/digest/disgest.htm#pubs
- United Ostomy Association: <http://www.uoa.org>
- Probiotics: <http://www.about-probiotics.org/>
- Ostomy Probiotics: www.fao.org/esn/foodandfoodprbioen.stm
- VSL#3: <http://www.vslpharma.com/vsl3/faq.htm>

CONCLUSION

It is clear that nutrition plays an important role in the management of patients with IBD. Unfortunately, there is no clear nutrition "formulation" that works best for all patients. Attention to weight changes, eating habits, and GI symptoms are the best guides for the clinician. Thorough, ongoing nutrition assessment and a multidisciplinary approach are keys to success. Table 8 provides a few useful websites for additional information on IBD and related topics. ■

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APPENDIX 1

Table 8 Products Containing Medium Chain Triglycerides (MCT)

MCT Oils						
Product	Description	Serving Size	g MCT/ serving	Kcal/ serving	Cost/ serving	Manufacturer
MCT Oil	Oil	1–3 Tablespoons	6–18	50–150	\$0.76–2.28	Mead-Johnson www.meadjohnson.com (800) 361-6323
MCT Oil	Oil	1–3 Tablespoons	6–18	50–150	\$1.04–3.14	CVS Pharmacies www.cvs.com
MCT Fuel	Oil	1–3 Tablespoons	6–18	50–150	\$0.42–1.28	Twin Labs http://www.iherb.com/mctl.html
MCT Power (Tropical Punch Flavor)	Oil	1-3 Tablespoons	6-18	50-150	\$0.53-1.59	Universal Nutrition (800) 872-0101 www.universaln nutrition.com
MCT Oil Containing Products*						
Lipisorb	Liquid nutritional	240 mL	11	240	\$3.50	CVS Pharmacies www.cvs.com
Nutren 1.5, unflavored	Liquid nutritional	250 mL	11	375	\$1.50	Nestle www.nestleclinicalnutrition.com (800) 776-5446
Nutren 2.0	Liquid nutritional	250 mL	20	500	\$5.98	Nestle www.nestleclinicalnutrition.com (800) 776-5446
Promote	Liquid nutritional	240 mL	5.0	240	\$1.85	Ross www.ross.com (800) 258-7677

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*Can increase calorie content and palatability with sherbet or sorbets