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Review

Nutrition and HIV infection

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Human immunodeficiency virus (HIV) infection and the development of AIDS (acquired immunodeficiency syndrome) is beginning to be appreciated as a chronic, progressive disease. The impact of this disease on nutritional status is manifested most blatantly in the "wasting syndrome," but is seen in the vast majority of patients to a lesser extent. What is perhaps not as well recognized is the impact of malnutrition on the underlying immune competence of the individual and on the course of the HIV infection. The causes of malnutrition in this population are related to decreased nutrient intake, malabsorption, and altered metabolism in the setting of chronic HIV infection as well as intercurrent secondary infection. Management strategies for the treatment of malnutrition in patients with HIV infection should include, at a baseline, a high index of suspicion and early recognition of malnutrition. Processes underlying the development of malnutrition must be sought out and treated if possible. The goals of nutritional intervention should be to preserve lean body mass and provide adequate nutrients as well as to minimize symptoms of malabsorption and improve quality of life. Options for specific nutritional therapy range from oral supplements to home TPN (total parenteral nutrition) and this must be individualized for each patient. (J. Nutr. Biochem. 6:2–11, 1995.)

Keywords: AIDS; malnutrition; nutritional assessment; nutritional support

Introduction

The relationship between nutrition and HIV (human immunodeficiency virus) infection is a double-edged sword: HIV infection and the subsequent development of AIDS (acquired immunodeficiency syndrome) has a profound effect on nutritional status, and malnutrition itself is related to mortality in AIDS both via depletion of body cell mass[1] and by alteration of immune function in the immunocompromised host.[2–10]

In order to address the broad topic of nutrition and HIV infection, there are specific questions that must be asked: (1) How do we identify and diagnose malnutrition in a patient who is HIV positive? (2) Is there a patient subpopulation that is more susceptible to wasting and malnutrition? (3) What are the causes of malnutrition? (4) Are there particular micro- or macronutrient deficiencies in the HIV infected? (5) Does refeeding have any impact on disease outcome? (6) What are the indications for enteral or parenteral nutrition support?

Current guidelines for nutritional support in AIDS are aimed at improving nutritional status and alleviating symptoms: specific goals include preservation of lean body mass, provision of adequate nutrients, and minimization of the symptoms of malabsorption as well as improvement of quality of life.[13] AIDS is a progressive disease for which curative therapy does not exist. The disease as well as its treatments can cause significant morbidity. Whether or not early nutritional intervention has a role in changing the course of disease in terms of survival, functional status, or less frequent infections remains to be seen. In the setting of late-stage HIV disease, quality of life must be the parameter that guides nutritional intervention.

Malnutrition and wasting in HIV and AIDS: the nature of the beast

Weight loss of <10% of body weight in an HIV positive patient is considered to be disease defining for AIDS. The reported wasting and weight loss in HIV disease is the result of malnutrition which may be explained in terms of decreased dietary intake, altered metabolism in the face of chronic and intercurrent infection, and by malabsorption.

The prevalence of the "wasting syndrome" ranges from 11 to 80% among AIDS patients.[14,15] In a recent retrospective review of national AIDS surveillance data (147,225 individuals), the proportion of AIDS patients reported with wasting syndrome varied by geographic distribution, ranging from 11% in the northeastern United States to 47% in Puerto Rico.[16] Some of these differences may be reflective of different diagnostic and reporting practices. In this study,

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AIDS indicator conditions most strongly associated with wasting were isosporiasis, pulmonary or esophageal candidiasis, HIV encephalopathy, chronic mucocutaneous Herpes simplex, and coccidiomycosis. In another study of HIV-positive males followed for 6.5 years, predictors of weight loss included fever, oral thrush, CD_4 counts < 100 cells/μL, and development of AIDS.[17] Diarrhea also correlated with weight loss, although less strongly.

Body weight

It has been suggested that progressive involuntary weight loss typically appears in the early stages of HIV infection and increases in severity as the disease progresses.[18] More recent data supports the hypothesis linking rapid weight loss (defined as loss of >4 kg in <4 months) and nongastrointestinal secondary infections (*Pneumocystis carinii*, Cytomegalovirus, Cryptococcal meningitis, Tuberculosis, salmonellosis, and bacterial chest infections). Slower weight loss (>4 kg in >4 months) was more characteristic of patients with underlying gastrointestinal disease[19] (*Figure 1*). The most frequently seen pattern of weight loss was that of rapid weight loss with subsequent weight stability or gain. Weight stability and weight gain in the HIV population with AIDS currently is mostly related to recovery from opportunistic infection.[19,20]

Data for patients with asymptomatic HIV infection is lacking. In one small study comparing nutritional status in asymptomatic HIV positive patients to those with ARC (AIDS related complex), there was a trend toward a decrease in body weight in patients with more advanced disease.[21]

Certainly, a patient's weight is a simple and readily available index of nutritional status in patients with HIV disease.[22] Weight loss is correlated to time of death: Chlebowski showed that for weight loss, median survival of 520 vs. 48 days occurred in patients with <10% vs. >20% baseline weight loss, respectively.[23] This marker must be obtained by trained staff, on an accurate scale with the patient in the same amount of clothes. Despite the fact that interpretation of body weight is confounded in both acute and chronic illness by effects of diarrhea, dehydration, hypoalbuminemia, lean tissue loss, and fluid overload, it remains a useful tool. Documentation of weight changes and recognition of patterns of weight change over time may be invaluable information in terms of intervention—diagnostically, therapeutically, and nutritionally—and should be a minimal standard of care for all HIV-infected patients.

Body composition

In HIV-infected patients, there are qualitative changes in body composition associated with wasting and malnutrition. Measurement of body cell mass (defined as the active cellular tissue in the body) by calculation of total body potassium, and body fat content shows body cell mass depletion proportionally greater than either reductions in body weight or body fat.[14] The percentage of body weight as water is higher in immunodeficient patients. This qualitative pattern of weight change occurs in end-stage AIDS and resembles other cytokine-mediated cachexia. This is in contrast with weight loss from starvation not complicated by infection in which there is proportionally greater fat loss and lean tissue loss.

The technique of bioelectric impedance analysis (BIA) has recently been used in the clinical investigation of malnutrition in HIV-infected patients.[24,25] This technique is readily carried out in an office setting and can provide accurate estimates of body cell mass and fat-free mass by measurements of reactance and resistance.[26] These measurements of body cell mass correlate highly with those obtained by measurements of total body potassium. In HIV-positive asymptomatic individuals, there is a decrease in body cell mass measured by BIA not noted by changes in body weight. This therefore may prove to be a useful tool for following patients infected with the HIV virus throughout the course of their disease.

Circulating proteins are also affected by HIV infection and AIDS. Serum albumin levels are lower in patients with AIDS and ARC than in healthy controls.[27] As a nutritional marker, serum albumin has shown utility in AIDS patients: with serum albumin <2.5 g/dL median survival is significantly shorter than with albumin >3.5 g/dL (17 days vs. >960 days, respectively).[23] The problem of using albumin or other circulating proteins (total protein, prealbumin, retinol binding protein) as nutritional markers is that they are affected by non-nutritional factors (infection, altered vas-

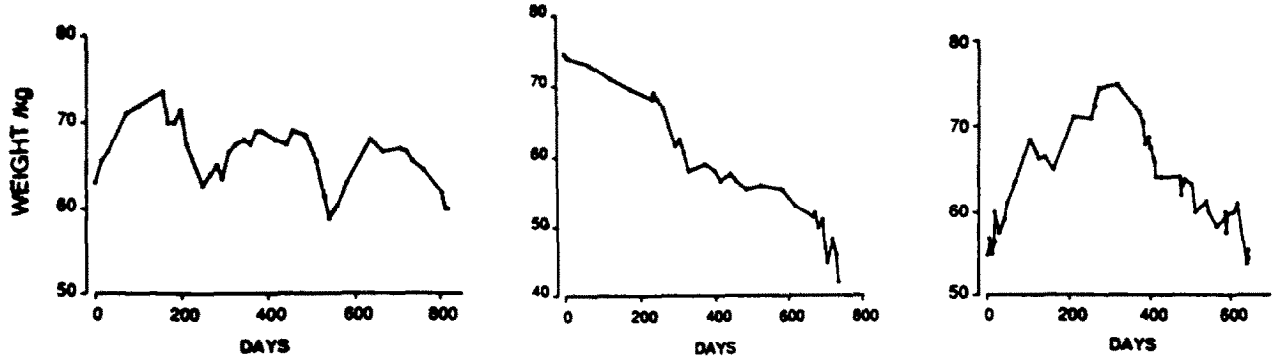

Figure 1 Patterns of weight change in AIDS: there may be episodes of acute weight loss with episodes of recovery, chronic progressive weight loss, or phases of weight gain (adapted from Ref. 19 with permission).

cular permeability, state of hydration) and must be considered in the overall context of the patient's status.

Decreased cholesterol levels[28] and increased serum triglyceride levels[29] in AIDS may be reflective of altered substrate metabolism. Whether this is secondary to the HIV infection or altered intake is unknown.

Micronutrient status in HIV infection

Vitamins and minerals are important as measures of nutritional status and exert direct effects on immune system function[18] but interpretation of different levels may be difficult for several reasons. In the homosexual HIV-positive population, up to 57% are taking high doses of vitamins and minerals.[30] Accurate assessment of micronutrient status is hampered additionally by inadequate reporting of disease stage and the nature of some micronutrients as acute phase reactants.

Vitamin B_{12} deficiency may occur in up to 27% of patients with AIDS.[31] It has been postulated that this may be due to malabsorption because of diarrhea (*Table 1*). More recently, gastric secretory failure in HIV infection with concomitant intrinsic factor deficiency and decreased B_{12} absorption has been postulated to play a role.[32] Folate levels are decreased in up to 33% of AIDS patients.[33]

Serum minerals studied in AIDS include zinc, selenium, and iron. Serum zinc levels are low in HIV-infected individuals and further decrease with progression to AIDS.[34] Selenium deficiency, as measured in whole blood or serum, has also been found to be a common component of the malnutrition seen in AIDS with levels significantly lower than the levels in controls.[35]

Iron status is more difficult to address because of the effects of intercurrent infection and frequent phlebotomy in this population. In patients with AIDS, ferritin levels are increased and serum iron and iron binding capacity are decreased.[36]

Causes of malnutrition in HIV infection

Many of the features of malnutrition and wasting seen in AIDS are similar to those seen in other infections and malignancies. Confounding factors in AIDS are the multiplicity of possible causes that contribute independently to the syndrome of wasting and the chronic nature of HIV infection and recurrent secondary infections. There are two broad categories to consider in the genesis of malnutrition in the HIV-positive population: (1) decreased nutrient intake and absorption, (2) metabolic derangement in the face of chronic HIV infection.

Decreased nutrient intake

It is widely believed that decreased nutrient intake plays an important role in the development of malnutrition in HIV-positive patients, but published evidence supporting this view is sparse. Chlebowski et al. reported reduced energy intake in patients with AIDS compared with HIV-positive patients (2,048 ± 193 vs. 2,314 ± 117 kcal/day, respectively) based on 7 day dietary records.[41] Dworkin et al., on the other hand, found no differences in dietary intakes among patients with AIDS, ARC, and asymptomatic HIV-positive controls.[42] Protein intakes were adequate in all these groups but up to 88% of patients in each group were reportedly ingesting less than 50% of the Recommended Dietary Allowance for at least one micronutrient.

Table 1 Changes in nutritional status in HIV infection, ARC, and AIDS (from Ref. 18 with permission)*

Nutrient	Asymptomatic HIV infection	ARC	AIDS
Protein	Total protein ↑ Albumin ↓; normal Retinol-binding protein ↓ Normal	Albumin ↓ Retinol-binding protein ↓ Total iron-binding acpacity ↓	Albumin ↓; ↓ ↓ Retinol-binding protein ↓ Total protein ↑ Total iron-binding capacity ↓
Amino acids			Most serum amino acids ↓
Lipids	Triglycerides ↑ Plasma fatty acids normal Cholesterol ↓ before Seroconversion	Cholesterol ↓	Triglycerides ↑ ↑ Fatty acids ↓ Cholesterol normal ↓
Folate	Serum and erythrocyte folate ↑		Folate in CNS ↓ Serum and erythrocyte folate ↓
Vitamin B_{12}	Cobalamin ↓	Cobalamin ↓	Cobalamin ↓
Vitamin B_6	B6 ↓		
Zinc	Serum zinc ↓; normal Erythrocyte zinc ↑, normal Zinc-thymulin ↓	Serum zinc ↓	Serum zinc ↓ Zinc-thymulin ↓ Zinc taste test ↓
Selenium	Serum selenium ↓		Plasma or serum selenium ↓ Erythrocyte selenium ↓ Cardiac selenium ↓
Copper	Serum copper ↓; normal		Serum copper normal
Iron	Ferritin ↓ Serium iron ↓		Ferritin normal Serium iron ↓ ↓ Hemoglobin ↓

↑ or ↓, levels higher or lower than normal laboratory values or levels in unifected control subjects; ↑ ↑ or ↓ ↓, levels higher or lower than in controls and/or subjects with HIV infection.
*This table represents a compilation of studies and differing changes (i.e., increased/normal) may be noted based on various studies.

Nutrient intake during intercurrent infections has not been well documented, but this may prove to be an important parameter in patients with acute weight loss. The causes of impaired oral intake in HIV disease are multifactorial. Pathology of the oropharynx and esophagus (*Table 2*) is often responsible for decreased oral intake. Disordered mentation, which is seen in late-stage AIDS may also be an important factor mediating poor oral intake. Psychosocial features of the disease including depression, lack of social support systems and poverty, may make nutritional adequacy difficult. One large, not often appreciated cause of poor oral intake in this population is related to the numerous medications which are used to treat the HIV infection as well as opportunistic infections which augment symptoms of anorexia and gastrointestinal distress (*Table 3*). A final cause to consider is the anorexia seen in later stages of the disease which may be related to increased levels of cytokines, such as TNF and IL-1.[43,44]

Malabsorption

Diarrhea is a common complication in patients infected with the HIV virus, occurring in 30 to 60% of North American and European patients and in nearly 90% of patients in developing countries.[45–47] Infectious etiologies include bacteria, Giardia, Cryptospordium, Microspordium, Salmonella, Campylobacter, and atypical Mycobacteria (*Table 4*).[48] Viral pathogens such as Herpes simplex and Cytomegalovirus have also been associated with diarrhea as has the HIV virus.[49,50] Malnutrition itself may contribute to the development of diarrhea by virtue of the loss of intestinal mucosal mass and absorptive capability.

Most patients with AIDS who develop diarrhea have some degree of malabsorption.[51,52] This is documented by abnormal D-xylose and hydrogen breath tests.[53] Lactase deficiency has also been shown.[54] Vitamin B_{12} malabsorption has previously been discussed.

The fact that diarrhea contributes to the development of malnutrition and weight loss is suggested because patients with AIDS who develop diarrhea have greater weight loss than patients who do not.[55] Often patients with diarrhea will have slow rates of weight loss.[19] When diarrhea is chronic and accompanied by inanition, the sense of well-being and the ability to carry out the activities of daily living are impaired.[73]

Table 2 Oral and esophageal manifestations of AIDS that interfere with food intake

Condition	Signs and symptoms*
Candidiasis	Pain, dysphagia, odynophagia, nausea, decreased salivation
Cytomegalovirus	Dysphagia, odynophagia (rare), esophagitis, esophageal ulcer
Hepes simplex virus	Dysphagia, odynophagia, esophagitis
Kaposi's sarcoma	Dysphagia, obstruction
Non-Hodgkin's lymphoma	Dysphagia
Cryptosporidiosis	Dysphagia

*Dysphagia = difficulty swallowing; odynophagia = painful swallowing.

Metabolic derangement in HIV infection and AIDS

Metabolic disturbances that could contribute to the development of wasting in AIDS include hypermetabolism (particularly in the presence of secondary infection), protein wasting, inappropriate use of metabolic substrates, futile cycling of substrates, and the presence of cytokines which promote altered metabolism (cachectin hypothesis.[55] Data directly linking these disturbances to wasting, however, are lacking.

HIV infection and the subsequent development of AIDS follows a chronic progressive course marked by intercurrent infection or malignancy often with partial recovery from intermittent infectious insults in between. Energy expenditure has been studied in different stages of HIV infection.[37–40] Most investigators have shown that resting energy expenditure (REE) is increased. This is seen even in the absence of acute secondary infections[37,38] and in HIV positive patients without AIDS.[39]

In a study by Grunfeld et al.[39] HIV-positive subjects, AIDS patients, and AIDS patients with secondary infections (AIDS-SI) were compared with controls with respect to weight, REE, and caloric intake. This study documented an increased REE in HIV positive asymptomatic subjects of 11%, in AIDS patients of 25%, and in AIDS-SI patients of 29%. Caloric intake allowed weight to be maintained in the HIV-positive and AIDS patients but AIDS patients with secondary infections had decreased intakes (17% less calories) and subsequently decreased weight (*Figure 2*). The authors suggest that in the AIDS-SI population, there is an inability to decrease REE in the face of decreased caloric intake (as occurs in simple starvation) and therefore there is acceleration of weight loss. An important consideration is that in patients with AIDS or asymptomatic HIV infection, weight is maintained in the face of increased REE by virtue of decreased physical activity.

In contrast to these findings, Kotler et al. observed a decrease in REE (by 16%) compared with energy expenditure predicted on the basis of the Harris–Benedict equation.[40] In this particular study, however, it should be noted that measurements were made in patients who were severely malnourished (with a body mass 27% lower than controls) and could be a reflection of starvation-induced reduction in energy expenditure.

Evidence that a simple starvation model is incomplete in explaining HIV associated wasting is suggested by several facts. Body compositional studies showing qualitative weight change with proportionally greater lean body mass loss compared with fat[14] loss is suggestive of cytokine-mediated cachexia. Elevation of serum triglycerides, and free fatty acids and increased hepatic fatty acid synthesis may be reflective of an altered mechanism for weight maintenance in AIDS.[43,44] High levels of cytokines, including TNF, interferon, and IL-1[56] are thought to mediate these altered metabolic responses in the face of HIV and secondary infections.

Table 3 Side effects and effects on nutritional status of drugs frequently used in the treatment of AIDS and AIDS-related infections (adapted from Ref. 18 with permission)

Drug	Use	Possible side effects or nutritional interactions
Azidothymidine	HIV infection,	Nausea, dysgeusia, edema of tongue and lips, mouth ulcers, constipation, reduced serum Vitamin B_{12}
Didanosine	HIV infection	Pancreatitis
Acyclovir	Herpes simplex	Diarrhea, nausea, vomiting, fatigue, sore throat, dysgeusia, nephrotoxicity
Gancyclovir	Cytomegalovirus, herpes viruses	Nausea, anorexia
Foscarnet	Cytomegalovirus, hepatitis B, herpes viruses	Nausea, headache, fatigue, neurologic impairment, calcium imbalance, hyperphosphatemia
Rifabutin	Mycobacterium avuim-complex	Possible liver dysfunction, dysgeusia, headache, anorexia, fatigue, absorption
Sulfadiazine	Toxoplasma gondii	Nausea, vomiting, anorexia, diarrhea
Pentamidine	Pneumocystis carinii	Nephrotoxicity, nausea, vomiting, hypoglycemia, pancreatitis, folate deficiency, dysgeusia, possible diabetes
Amphotericin B	Cryptococcal meningitis	Possible decreased potassium and magnesium levels, weight loss, anorexia. Nausea, vomiting, diarrhea, severe nephrotoxicity
Ketoconazole	Esophageal and oral candidiasis,	Nausea, vomiting, abdominal pains, decreased sodium
Nystatin	Candidiasis	Diarrhea, nausea, vomiting, fever gastrointestinal distress
Trimethoprim	Pneumocystis carinii pneumonia	Pancreatitis, anorexia, glucose intolerance, folate deficiency, glossitis, stomatitis

Table 4 Differential diagnosis of diarrhea in AIDS

INFECTION
Bacterial- Salmonella*
- Shigella, Campylobacter*
- Mycobacterium avium intracellulare
- Mycobacterium tuberculosis
Protozoal- Cryptosporidium*
- Isospora belli*
- Microsporidium*
- Giardia lamblia
- Entamoeba hystolytica
- Blastocystis hominis
Viral- Cytomegalovirus
- Herpes simplex virus
- Adenovirus
Fungal- Histoplasmosis
- Coccidiomycosis
NEOPLASM
Lymphoma
Kaposis sarcoma
IDIOPATHIC
AIDS enteropathy

*Most commonly seen diagnosis

Management strategies for improving nutritional status

Traditionally, nutritional assessment and intervention have largely been addressed by health caregivers only when the AIDS patient is significantly malnourished. A trend toward earlier assessment and intervention is developing[57] and may prove to alter mortality and morbidity in this chronic disease. All management strategies should incorporate early routine nutritional assessment and counselling for the patients.[58]

Unproven nutritional therapies and unconventional diets, including vitamin megadosing, are frequently espoused by the HIV-positive population in attempt to have some degree of control over their own health in the face of this fatal disease. These dietary habits need to be uncovered in a nonconfrontational manner and addressed as part of the learning process for the patient. Practical dietary recommendations should be individualized and take into consideration anthropometric measurements, medical diagnoses, diet history, appetite, medications, supplements, and lifestyle[58] (*Table 5*).

Improvement in oral intake will be facilitated by treatment of oral and esophageal disease such as Candida or Herpes simplex infection. The use of appetite stimulants has recently been reported to be of benefit in patients who have anorexia as a prominent symptom. Megace (megestrol acetate) was originally used for the treatment of anorexia in patients with cancer[59] and more recently in patients with AIDS.[60] Patients do have weight gain but it has been suggested that there is an increase in body fat relative to lean body mass. Dronabinol, an orally active cannabinoid found in marijuana, has also been used as an appetite stimulant in HIV-positive patients[61] and may have some role in improving oral intake and causing weight gain. The efficacy of this type of therapy in the long-term has not been substantiated. The role of the patient's current pharmacopeia in contributing to poor oral intake through drug side effects or drug-nutrient interactions must also be assessed and changed if at all possible.

Another recently investigated agent for wasting in AIDS is recombinant human growth hormone (rHGH) which when given in pharmacological doses results in reversal of weight loss and repletion of lean tissue. This reversal is not maintained when therapy is discontinued. Side effects of rHGH included hyperglycemia. Its role in wasting and malnutrition in AIDS remains questionable at this time.[62]

In patients with diarrhea and malabsorption, a diagnosis must be sought and potentially treatable infections treated appropriately. It has been shown that nutritional status will improve with treatment of underlying infections in general

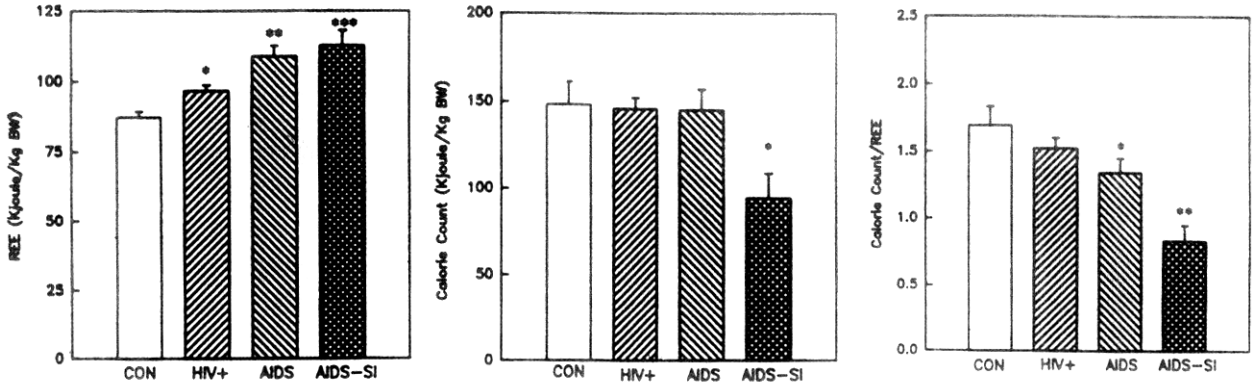

Figure 2 Left, resting energy expenditure (REE) in patients who are HIV positive is increased compared to control and the development of AIDS with or without secondary infection (*$P < 0.025$ vs. control, **$P < 0.0001$ vs. control group, and $P < 0.025$ vs. HIV+ group, ***$P < 0.0001$ vs. control and $P < 0.01$ vs. HIV+ group). Center, caloric intake is decreased in AIDS patients with secondary infection compared to controls, HIV+ and AIDS patients without secondary infection ($P < 0.02$). Right, the ratio of calorie count to REE in controls, HIV+, AIDS, and AIDS-SI groups. *$P < 0.002$ vs. control group, $P < 0.1$ vs. HIV+ group, $P < 0.02$ vs. AIDS-SI group. **$P < 0.0001$ vs. control, $P < 0.002$ vs. HIV+, $P < 0.02$ vs. AIDS group (from Ref. 38 with permission).

and with cytomegalovirus specifically.[20] Diarrhea that is not amenable or responsive to specific antibiotic or antiviral agents should be symptomatically treated with antidiarrheal agents. Octreotide is a somatostatin analog that has been shown to improve severe diarrhea in some patients with Cryptospordium.[63] Bulk-forming agents, including psyllium and bran, may be helpful in some cases. Other simple measures may include lactose restriction or lactase replacement in patients with lactase deficiency.

There have been no studies to suggest that treatment of the HIV virus itself will improve nutritional status, although positive treatment of asymptomatic HIV with zidovudine has been shown to prolong survival.[64] Other antiviral therapy is also evolving,[65] and one can hypothesize that with improved control of the HIV infection nutritional status may improve. There is less controversy about treatment of intercurrent opportunistic infections and improvement in nutritional parameters. Treatment or cure of these processes should be central to nutritional maintenance. At the same time, nutritional intake during secondary infections must be maintained in order to preserve lean body mass.

The goal of specific nutritional therapy in AIDS is to maintain metabolic homeostasis, including stable weight and body composition and normal nutritional indices. Guidelines for selecting patients who are candidates for nutritional support include the presence of significant weight loss (i.e., $\geq$10% below preillness weight), failure to increase or maintain body weight with usual food intake and/or oral liquid supplements, and the potential for improved quality of life. These potential benefits should be weighed carefully against the expense and risk of therapy in each case.[66] Estimated caloric and protein requirements differ from one clinical situation to the other and are influenced by many factors as previously discussed. An estimate of 25 to 35 kcal/body weight/day can be modified depending on the nutritional response in a given patient. Protein requirements range from 1 to 1.5 g/kg of usual body weight.[67]

Table 5 Nutritional assessment in HIV infection and AIDS: Considerations for dietary recommendations (adapted from Ref. 58)

Medical diagnoses	Opportunistic infection, neoplasm, fever
	Malabsorption, diarrhea (consider type)
	Malnutrition
Diet history	Symptoms (anorexia, nausea, diarrhea)
	Feeding problems (swallowing, chewing, self-feeding skills)
	Self rating of appetite
	Food patterns (recall, frequency, interest)
	Intake versus requirements
Medications and supplements	Prescription
	Over the counter
	Adjunct therapy
	Calorie-containing nutrient
	Non-calorie containing nutrients
	Non-nutrients (herbs, other supplements)
Lifestyle	Caffeine, alcohol, drug, tobacco use
	Sleep, exercise, stress, and coping mechanisms
	Psychosocial issues (including cultural habits)
	Economic and food access issues
Clinical exam, anthropometrics	Physical exam
	Nervous system, sight, organic brain dysfunction
	Weight for height
	Usual body weight compared with current weight
	Patterns of weight loss
	Body composition (fat and lean body mass)
	Skinfold measurements
	Arm muscle area (circumference, bioimpedance analysis)
Biochemical	Plasma proteins (consider drug therapy, acute and chronic disease)
	Lipids (triglycerides and cholesterol)
	Vitamin/mineral measures
	Electrolytes

Enteral nutrition

In patients with relatively normal gastrointestinal function, but in whom oral intake is limited, enteral nutritional support is the route of choice. If feeding is to be required for less than 6 weeks, a conventional, small-bore nasoenteric tube may be used. If feeding is expected to be required for longer periods, tube enterostomy (surgical or endoscopic) is easier to manage and better tolerated by patients. In patients at risk for aspiration, jejunal feeding is preferred.

The choice of formula used—elemental vs. polymeric, high vs. low fat, containing medium chain triglycerides—is determined by many factors including patient tolerance, gastrointestinal function, and cost. Failure to tolerate or improve clinically with enteral feeding is an indication for adding or switching to parenteral support.

Parenteral nutrition

Parenteral nutrition support in patients with AIDS is indicated in patients with bowel obstruction, severe refractory diarrhea, intractable vomiting, failure of enteral support as well as potential for improved quality of life. Parenteral support may be administered peripherally or centrally; PPN (peripheral parenteral nutrition) is used for short term (<7 to 10 days) support. TPN (total parenteral nutrition) is administered by central vein catheter to allow delivery of more protein, carbohydrate, and electrolytes. If support is required for longer than 1 to 2 months, permanent parenteral access should be obtained.

Standard or high-nitrogen (1.5 g protein/kg)–containing formulas may be administered. Intravenous lipids should also be infused, at least weekly, to prevent essential fatty acid deficiency. Electrolyte composition of the formula may be manipulated to compensate for deficiencies that may develop with excessive gastrointestinal losses.

The main complication of TPN in patients with AIDS is catheter infection. Although the rates of catheter sepsis have been reported to be similar to those seen in other populations,[68] some authors have documented increased rates of catheter infection.[69]

Several algorithms have been developed to help guide nutritional support in AIDS patients which can serve as useful parameters in the management of these multifaceted patients (*Figure 3*).

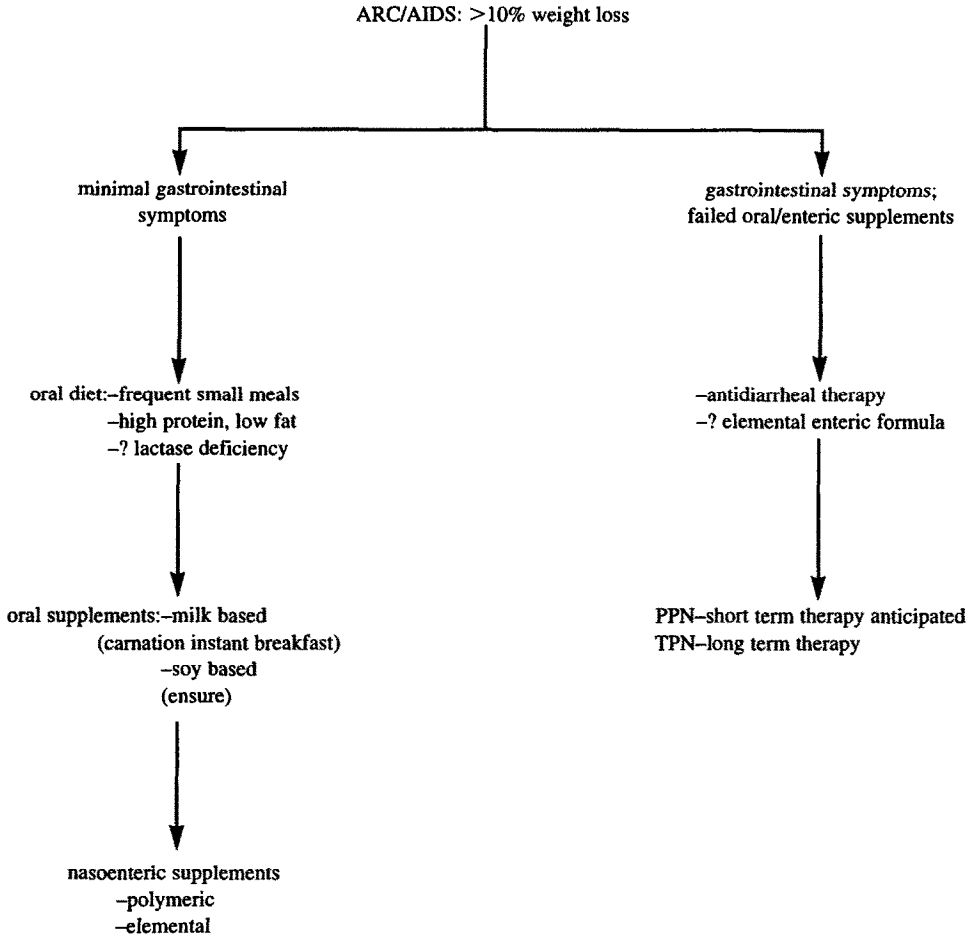

Figure 3 Nutritional therapy algorithms in ARC and AIDS.

Efficacy of nutritional support in HIV disease and AIDS

The specific goals of nutritional therapy in AIDS—preservation of lean body mass, provision of adequate nutrients, and minimization of the symptoms of malabsorption—may be achievable. In a study of eight severely malnourished patients (defined as weight loss >10% ideal body weight) fed a defined formula enteral diet via gastrostomy tube, Kotler et al. demonstrated increased body cell mass and body fat content.[11] The use of a low-fat, low-residue defined formula diet has been shown to significantly decrease the number of bowel movements compared with that on a usual diet.[70] In this study, there was also documented weight gain, but the study period was quite short (10 days). Parenteral nutrition has also been shown to improve nutritional status in patients with repletion of body mass, particularly in the setting of small intestinal injury[12] and diarrhea.[71] Although it is possible to replete lean body mass, an increase in body fat with an associated increase in body weight appears to be more common.[72] The ability of TPN to restore normal nutritional status in the face of overwhelming infection has not been demonstrated.

In a broader sense the term "efficacy" also encompasses outcomes of nutritional intervention with respect to mortality and morbidity, quality of life, and frequency of hospitalization. Although there is evidence that nutritional support can reverse wasting in AIDS patients[11,12] there is no evidence as yet to suggest that it affects mortality. The most straightforward evidence relating nutritional status and outcome in HIV-related disease has been studies of the magnitude of body cell mass depletion and timing of death from AIDS.[1] A progressive depletion of body cell mass until death was seen: with average body cell mass at death being 54% of normal (average body weight 66% of ideal). Effects on quality of life for patients with AIDS has been less well documented. Weaver et al.[71] noted that the response to aggressive nutritional intervention resulted in improvement in several indicators of quality of life, including more positive attitude, improved appetite, unassisted mobility, and increased energy level. There is literature to suggest that HIV-infected patients with diarrhea experience marked decreases in quality of life (parameters measured included use of health services, medications, work loss, global health, cognitive and social functions, and fatigue.[73] Nutritional intervention in this population warrants further investigation since there is potential for positively impacting upon the 50% of the HIV-positive population with prominent gastrointestinal symptoms.

The ability of early aggressive nutritional support to decrease hospitalization requirements by virtue of improving nutritional status is also an interesting avenue for investigation which has recently been looked at by Chlebowski (1993, personal communication). His group showed a decrease in the number of hospitalizations over a 6 month period in HIV-positive patients without overt gastrointestinal disease on oral nutritional supplements when compared with a nonsupplemented group. The question of whether to initiate aggressive nutritional support prior to the development of weight loss in terms of survival benefit has not been addressed.

AIDS has affected over 200,000 individuals in the United States. It is the leading cause of death in 25–44 year olds and is responsible for more deaths than the Vietnam War. It has been identified as the #1 public health priority in the United States. Because malnutrition and AIDS are so interrelated, nutritional intervention and therapy is a reasonable target for further investigations. It is vital to document the effect of nutritional therapy on immune function, organ-specific function, mortality, hospitalization, and, perhaps most importantly, quality of life for patients with this fatal disease. There is also a need for heightened awareness in the medical community for earlier nutritional counselling and recognition of maladaptive nutritional practice and malnutrition in the HIV-positive population.

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