Nutritional Status of Patients with Acquired Immunodeficiency Syndrome

C. M. Huang, Mark Ruddel, and Ronald J. Ellen

Nutritional status may be an important factor in the prognosis of morbidity and mortality. We assessed the nutritional status of individuals seropositive for human immunodeficiency virus (HIV) (as confirmed by Western blot) and of patients with AIDS, by determining the concentration in serum of total protein, albumin, prealbumin (transthyretin), and retinol-binding protein. HIV-serialpositive individuals showed no significant difference in albumin concentration when compared to normal volunteers for patients with AIDS, showed significantly smaller prealbumin and albumin concentrations than did normal and HIV-positive individuals. There was no significant difference in the concentration of retinol-binding protein among the three groups. The concentration of total serum protein was significantly greater in HIV-positive individuals and in patients with AIDS than in normal individuals. Thus, the nutritional status of patients with AIDS may be a factor for morbidity and mortality.

Additional Keyphrases: albumin • prealbumin (transthyretin) • retinol-binding protein

The patient infected with human immunodeficiency virus (HIV) may present with a variety of manifestations, ranging from asymptomatic infection to full-blown acquired immune deficiency syndrome (AIDS) accompanied by a life-threatening infection or malignancy (1-3).

1 The hallmark of cellular immune deficiency in AIDS is a depletion of the CD4-positive T helper cells, leading to a reversal of the T helper/CD8-positive T suppressor cell ratio (2-5). Fever, weight loss, and diarrhea usually precede the development of malignant or infectious complications (6, 7). AIDS patients with Kaposi’s sarcoma and weight loss have a poor prognosis (6). Thus, nutritional status may be an important prognostic factor for the patient’s morbidity and mortality (9).

Cell-mediated immunity, bactericidal function of neutrophils, the complement system, T helper/suppressor cell ratio, and the delayed hypersensitivity reaction are consistently depressed in malnourished patients (9-11). The incidence of postoperative sepsis and mortality is higher among subjects showing anthropometric or biochemical evidence of malnutrition (9, 12). In one study the incidence of diarrhea in children with wasting was more than twice as high as children without the syndrome; malnutrition also prolonged diarrhea by 33% in underweight children and by 79% in wasted children (13). The risk of opportunistic infection such as Pneumocystis carinii, tuberculosis, candida, and bacterial diarrhea is significantly higher in patients with protein-energy malnutrition than in well-nourished individuals (9).

Thus, there are similarities with regard to the clinical picture and secondary disease processes between AIDS and malnutrition.

Weight loss and diarrhea are frequently seen in AIDS patients (2, 3, 14), but the etiology of the weight loss and the biochemical evidence of malnutrition in patients with AIDS have not been studied. To assess the nutritional status of HIV-seropositive individuals and patients with AIDS, we determined the concentration of prealbumin (transthyretin), albumin, and retinol-binding protein (RBP).

Materials and Methods

Apparatus. We used a Cobas Bio centrifugal analyzer (Roche Analytic Instruments, Nutley, NJ 07110) for the prealbumin assay and a SMAC continuous-flow analyzer (Technicon Instruments Corp., Tarrytown, NY 10591) to quantify total protein and albumin.

Reagents. Goat antiserum monospecific to human prealbumin and reference sera (Calibrator 3) were obtained from Atlantic Antibodies, Scarborough, ME 04074. Phosphate-buffered saline (PBS, pH 7.4) was purchased from Quality Biological Inc., Gaithersburg, MD 20877. Polystyrene Glycol 6000 (PEG, M, 6000; Sigma Chemical Co., St. Louis, MO 63178) in PBS was used at a concentration of 40 g of PEG per liter of PBS (PEG-PBS). Initially, we used standard reference plasma (Behring Diagnostics, La Jolla, CA 92037) as a control serum. Later, we used pooled frozen assayed serum as a secondary control.

Specimens. Serum specimens received by the Clinical Chemistry Service for routine analysis were stored at 4 °C for as long as seven days before assay. We confirmed the diagnosis of AIDS in 57 patients from their medical records according to the criteria of the Centers for Disease Control (7). Twenty-seven HIV-seropositive individuals had anti-HIV antibody detectable by an enzyme-linked immunosorbent assay and confirmed by the Western blot technique. All HIV-positive individuals were asymomatic. We used as normal controls 23 blood donors who were seronegative for HIV and hepatitis B antigen.

Methods. To determine serum concentrations of prealbumin, we used a modification of the immunoturbidimetric method of Ledue et al. (15). Briefly, we mixed 4 μL of standard or patient’s serum with 200 μL of PEG-PBS. We incubated this mixture at 25 °C for 3 min and then recorded the absorbance at 340 nm as the blank. Next, we added 75 μL of the second reagent (antiserum to human prealbumin diluted sixfold with the PEG-PBS). Six minutes later we recorded the absorbance at 340 nm. The net change in absorbance was proportional to the concentration of prealbumin.

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Received April 20, 1988; accepted May 31, 1988.
We used a radial immunodiffusion technique to determine the RBP concentration (Ciba Biochem LP-partigen; Behring Diagnostics). Total protein and albumin concentrations were quantified by SAAAC with ready-to-use reagents provided by Technicon Instruments Corp.

Statistical analysis. We compared the means of the different groups by Student's t-test, adjusting for differences in variances when necessary. The results were analyzed with a nonparametric rank sum test (Kruskal–Wallis).

Results

The nutritional status of normal, HIV-positive individuals and patients with AIDS is presented in Table 1. The results for prealbumin, albumin, and RBP from HIV-positive individuals were not significantly different from those for normal individuals. However, the results for AIDS patients were significantly decreased ($P < 0.001$) for prealbumin and albumin concentrations as compared with HIV-positive and normal individuals.

Of the 27 HIV-positive individuals who had results outside the reference interval (mean ± 2 SD) for normal individuals, one (3.7%) showed a decreased albumin, one a decreased prealbumin, and 11 (40.7%) an increased total protein. A greater proportion of the 53 patients with AIDS had values outside the reference interval: three (5.7%) had decreased RBP, 19 (35.8%) had decreased albumin, 19 (35.8%) had decreased prealbumin, and three (5.7%) had decreased total protein—but 28 (52.8%) had increased total protein (Figure 1).

Discussion

Infectious complications are the most common cause of death in patients with AIDS [16–18]. Although the predominant defect is in T-cell function with a reversal of T

![Table 1. Nutritional Status of HIV-Seropositive Patients and Patients with AIDS](image)

<table>
<thead>
<tr>
<th></th>
<th>Normal (n = 23)</th>
<th>HIV+ (n = 27)</th>
<th>AIDS (n = 53)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total protein, g/L</td>
<td>64.8 ± 1.0</td>
<td>72.9 ± 0.9*</td>
<td>71.7 ± 1.3*</td>
</tr>
<tr>
<td>Albumin, g/L</td>
<td>43.3 ± 0.5</td>
<td>43.5 ± 0.5</td>
<td>39.5 ± 0.8*</td>
</tr>
<tr>
<td>Prealbumin, mg/L</td>
<td>266 ± 10.4</td>
<td>252 ± 13.7</td>
<td>194 ± 9.1*</td>
</tr>
<tr>
<td>Retinol-binding protein, mg/L</td>
<td>41.5 ± 2.3</td>
<td>42.6 ± 2.8</td>
<td>38.0 ± 1.9</td>
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*Significantly ($P < 0.005$) different from normal.

helper/suppressor cell ratio, a profound abnormality in B-cell function, decreased interleukin-2 production, and natural killer-cell cytotoxicity have also been observed in patients with AIDS (19, 20). Furthermore, the protein–calorie malnutrition, manifested by weight loss and hypoalbuminemia, may further impair cellular and humoral immunity and phagocytic function. As a result of the poor nutritional status, the susceptibility of the host to infection such as Pneumocystis carinii, candida, tuberculosis, herpes, and bacterial diarrhea is increased (19). Recurrent infection by these organisms also is commonly seen in AIDS patients. When opportunistic infection intervenes, it in turn leads to more severe malnutrition. This vicious circle may accelerate the death of the patient.

Although weight loss is a common manifestation and heralds infection in a patient with AIDS, the etiology of the weight loss and the biochemical evidence of malnutrition are not established. In this study, we found that HIV-positive individuals showed no significant difference from normal individuals for prealbumin, albumin, and RBP. However, the nutritional status of AIDS patients is significantly impaired, as evidenced by a significant decrease of prealbumin and albumin. Prealbumin and RBP, synthesized in the liver, with biological half-lives of 46 h and 8 h, respectively, may be a better indicator of nutritional status and liver function than is albumin (21–23). The etiology of weight loss may be multifactorial, resulting from the gastrointestinal syndrome (24) as well as liver malfunction. The significantly increased serum total protein for HIV-positive individuals and AIDS patients is the result of hyperimmunoglobulinemia because of B-cell activation (3, 20).

The lack of change in RBP concentration among the three groups is not entirely clear. Patients with renal disease tend to decrease the metabolic clearance of the free RBP through renal glomeruli and increase the concentration of RBP, whereas the prealbumin concentration remains unaffected (25). With multi-organ involvement of the HIV infection, there is frequently some renal failure. Thus, patients with AIDS may have competing processes that stabilize the RBP concentration: decreased synthesis by the liver but a decreased rate of clearance by the kidney.

References