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Nutrition Supplements in Dialysis Patients: Use in Peritoneal Dialysis Patients and Diabetic Patients

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Malnutrition is common in dialysis patients. Low serum albumin is associated with increased mortality. Nutrition supplements have been used with success in dialysis patients in increasing serum albumin levels. The National Kidney Foundation of South Carolina Nutrition Supplement Program provides grants for supplements. We studied the effect of supplements on albumin levels in peritoneal dialysis (PD) patients, hemodialysis (HD) patients, and dialysis patients with diabetes.

Dialysis patients with any combination of an annual income of less than $24,000, a documented albumin level of 35 g/L or under, or significant weight loss were provided with 3 months of nutrition supplements. Albumin levels and weight were tracked for 3 months before, 3 months during, and 3 months after the supplement use.

The study included 190 patients (157 on HD, 33 on PD). Serum albumin was significantly higher in HD patients than in PD patients during all study periods (before, during, and after supplement; $p < 0.05$*). In the 121 dialysis patients with diabetes, we observed a significant increase in albumin during supplement period (*$p \leq 0.05$*). The improvement persisted after the supplement was stopped. Patients on PD had no significant increase in weight or albumin level during or after the supplement period.*

Nutrition supplements in dialysis patients lead to a significant improvement in serum albumin in HD patients, but no similar improvement in PD patients. Dialysis patients with diabetes had a significant improvement in serum albumin identical to that in dialysis patients without diabetes. Improved serum albumin levels could lead to decreased morbidity and mortality, but the relationship between supplement use and mortality needs further study.

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Introduction

Malnutrition is common both in hemodialysis (HD) and in peritoneal dialysis (PD) patients. Several studies have observed the incidence to range from 10% – 70% in HD patients and 18% – 51% in continuous ambulatory PD (CAPD) patients (1,2). Inadequate intakes of protein and calories affect nutrition status, and intakes of energy and protein for many dialysis patients are lower than the recommended requirements (3).

Serum albumin has been used as a marker for nutrition status, and an increase in morbidity and mortality has been shown for end-stage renal disease patients whose albumin is below 40 g/dL (4). This inverse relationship between serum albumin and morbidity and mortality in dialysis patients has also been confirmed in other studies (5–7).

The process of dialysis can itself affect the inflammatory status of patients. Hakim and Levin (8) grouped the factors that affect nutrition status: dialysis factors, biochemical factors, gastrointestinal factors, miscellaneous factors, and low socio-economic status. Miscellaneous factors include depression, multiple medications, recurrent hospitalizations, and underlying illness.

Dialysis modality can also be a factor in serum albumin level. Because of protein loss during PD fluid exchanges, patients on PD tend to have a lower albumin than do patients on HD. Daily loss of protein ranged from 5.5 g to 11.8 g in CAPD patients (9). Patients on HD lost 4.5 – 7.6 g amino acids per treatment from low-flux dialyzers (10).

Sezer *et al.* concluded that hypoalbuminemia is multifactorial in CAPD—with older age, cause of renal failure, transport status, chronic inflammation, and presence of nephrotic syndrome affecting nutrition status (11). Abdominal discomfort from the presence

of dialysis fluid in the abdominal cavity and from peritonitis can both cause anorexia. Peritonitis also causes increased protein losses of 15.1 g protein daily (12). Dialysis fluids can also affect gastric emptying and intestinal motility (13). Overhydration in PD can also be a cause of hypoalbuminemia (14).

Comorbid conditions can affect serum albumin through various mechanisms (15). Inflammation as a result of pulmonary, skin, and bladder infection is common in dialysis patients. Levin and Kotanko described the presence of periodontal disease in up to 78% of dialysis patients in North Carolina and New York (16). Laville and Fouque estimated that maintenance HD patients who are hospitalized will miss approximately 20% of their lunches and dinners, which will result in a 3000-calorie deficit over a week (17). Age and diabetes are also associated with lower serum albumin (18). Bossola *et al.* showed that age was significantly associated with an inadequate dietary energy and protein intake (19).

Factors that contribute to malnutrition in dialysis patients remain ever-present in our population. Information from the 2007 U.S. Renal Data System (USRDS) annual report describes the characteristics of the 341,000 dialysis patients in the United States. Median age is 64.6 years, and the greatest increase in population is occurring in the 45–64 age range, but the highest rate of patients on dialysis is found among people more than 65 years of age. Diabetes is the primary cause of kidney failure for 44.8% of patients.

The USRDS report describes the disabilities that might affect quality of life and activities of daily living for dialysis patients. These disabilities include blindness, amputation, paralysis or paresis, and dementia. Microvascular complications such as blindness, peripheral vascular disease leading to amputations, and macrovascular disease of diabetes leading to stroke and dementia all affect the nutrition status of the individual. Dementia is the most common disability in chronic kidney disease, and amputation is the most common disability among dialysis patients. Patients on HD have a greater number of disabilities than do patients on PD, and patients with diabetes have a higher percentage of disabilities than do patients without diabetes (20).

Several documented studies have shown that the provision of oral nutrition supplements is effective as an intervention in the treatment of malnutrition (21–29). Oral nutritional supplementation has been described as effective in increasing serum albumin in dialysis patients. Sharma *et al.* showed a significant increase in albumin level in the short term with an intervention involving nutrition supplements (22). Steiber *et al.* concluded that intervention with nutrition supplements of the patient's choice reduced the risk of hospitalization (23). Stratton *et al.* reported that serum albumin concentrations improved by 0.23 g/dL and total protein intake improved with the use of enteral nutrition support (24). Boudville *et al.* showed that the addition of an oral nutrition supplement 30 minutes before lunch resulted in an increase in mean caloric and protein intake (25). Other studies have also shown improvement in dietary protein and calorie intake with nutrition supplements (26).

In a previous work, we showed that mean albumin levels for 130 patients increased after a 3-month intervention with nutrition supplements ($p < 0.004$) and the improvement in albumin level persisted even after the supplements were stopped. Patients with albumin levels below 3.0 mg/dL received the most benefit from the nutrition supplements (27).

In trying to understand the effectiveness of nutrition supplements, we studied patients who were granted such supplements by the National Kidney Foundation of South Carolina (NKF–SC). We observed the effect on serum albumin and weight between PD and HD patients, and between diabetic and nondiabetic patients.

Patients and methods

The NKF–SC has a nutrition supplement program that has been in place since August of 2002. The budget for this program is included under Patient Services. The program grants a specific dollar amount of supplements to lower income patients who are not receiving SC Medicaid. Patients who receive SC Medicaid are already eligible to receive nutrition supplements through a program in the state (27). For the purpose of the NKF–SC program application, total annual household income should be less than $24,000, and the patient should either have low serum albumin (below 35 g/L during 2 of 3 months) or documented weight loss of more than 5% for 1 month or of more than 10% for 6 months (27). The application includes a place for documentation of a 3-month history of recent weight and albumin levels. Medical history from patient records is reviewed. Hospitalizations and other risk factors influencing albumin and weight are described.

Data from patient interviews are also included. The physician signs the form indicating agreement with the transcription of the data.

The dietitian at the dialysis clinic applies for a 3-month supply of liquid or powdered nutrition supplements for the patient (2 cans daily of liquid supplement, or 6 scoops daily of powdered protein supplement). Patients requesting liquid diabetic supplements received 1 can of liquid supplement daily, keeping the total cost per patient similar.

In the present study, the amount and type of supplements varied. Patients receiving a nondiabetic supplement received a 3-month supply (2 cans daily, providing a total of 20 – 30 g protein and approximately 500 calories). Patients receiving a supplement specifically for diabetes, received a 3-month supply (1 can daily, providing 13.8 g protein and 250 calories). Powdered supplements provided 30 g protein daily and minimal calories.

The supplements received by the patients were based on equal cost value, and so patients receiving liquid diabetic supplements (which cost more) received fewer units than did the patients receiving nondiabetic product. The supplements chosen for this program were based on product cost and available funds. Oral supplements that could be selected were Boost, Boost Plus, Boost HP, and Boost Diabetic (Novartis Nutrition, Minneapolis, MN, U.S.A.). The powdered protein supplement used was Procel (Global Health Products, Rochester, NY, U.S.A.).

The completed program forms are forwarded to the NKF–SC, and a committee consisting of the coordinator of Patient Services and 1 – 2 dietitians reviews each application. When the application is approved, the supplements are shipped to the patient's dialysis facility, where the dietitian distributes the supplements to the patients. There are 6 application deadlines each year.

Once the supplements are distributed, the dietitians track albumin levels for 6 months: 3 months during the use of the supplement, and the 3 months following supplement consumption.

Results

Our study included 190 patients (33 on PD, 157 on HD). Statistically significant improvements in albumin level were observed in the HD patients, but albumin levels did not change in the PD patients. Albumin was significantly higher in HD than in PD patients during all study periods (before, during, and after supplement use; $p < 0.05$). The difference in serum albumin between HD and PD patients widened during the period when the supplement was provided and the gap remained after the supplement was stopped (Figure 1).

A review of documented infections showed that 36.8% of HD patients and 42.4% of the PD patients had 1 or more episodes of infection that were treated during the 6 months of tracking after supplement start. During the same 6 months, 41.8% of the HD patients and 36.4% of the PD patients experienced 1 or more hospitalizations. No statistical difference was found in the rates of infection or hospitalization.

Of the 33 PD patients included (mean age: 54.6 years), 18 were male, and 15 were female. No statistically significant increase in weight or albumin level occurred during the supplement period (months 4, 5, 6). No drop in albumin level was noted in the 3-month follow-up period (months 7, 8, 9; Table I)

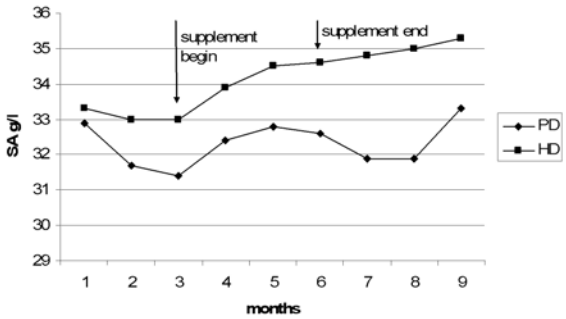

FIGURE 1 Serum albumin (SA) levels before, during, and after the nutrition supplement in hemodialysis (HD) and peritoneal dialysis (PD) patients.

TABLE I Serum albumin and weight changes in the months before, during, and after the nutrition supplement

Parameter	*Before supplement*			*During supplement*			*After supplement*		
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Albumin (g/L)	32.7	31.6	31.5	32.3	32.7	32.6	31.7	31.8	33.1
Weight (kg)	73.3	73.3	73.1	71.2	69.8	70.9	71.2	72.5	72.9

Comorbid conditions for the PD patients were reviewed. The most common comorbid conditions were diabetes mellitus (11 patients), gastrointestinal disorders (11), infections (8), heart disease (7), and age over 65 years (7).

We studied the effect of nutrition supplements in patients with diabetes mellitus (n = 121; 110 on HD, 11 on PD). We observed a significant improvement in albumin level during months 4 – 6 (supplement period). This improvement persisted after the supplement was stopped (Figure 2).

Discussion

Our study tried to clarify the role of nutrition supplements in dialysis patients, with a closer look at differences in the HD, PD, and diabetes subgroups.

The HD patients experienced a higher incidence of hospitalization. The HD patients who received supplements frequently had a recent hospitalization listed on their application. Amputations, cardiac events, or infections were among the reasons for the hospitalizations. Hospitalizations may have led to a decrease in oral intake in the hospital because of procedures or because of foods not considered palatable. Infection is a catabolic state requiring increased calorie and protein intake. Similarly, cases of wounds and amputations require increased protein and calories for healing. Amputations were most commonly seen in the HD patients. Albumin levels of the patients with amputations improved after wounds were healed.

The PD patients had a higher incidence of infections, including peritonitis or exit-site infection that could be treated on an outpatient basis. Peritonitis in the PD population would have increased the permeability of the peritoneal membrane, causing increased loss of protein until the peritonitis resolved. Fox, Tzamaloukas, and Murata (28) studied albumin levels and recovery time for both routine peritonitis and persistent peritonitis in PD patients. They found significant differences, with greater percentage decreases in albumin and increased time for recovery with persistent peritonitis than with routine peritonitis. The type of peritonitis in patients receiving nutrition supplements from the NKF–SC program was not determined. Of the 33 PD patients in the study, 6 had 1 or more separate episodes of peritonitis, but whether that peritonitis was routine or persistent is unknown. Antibiotics used to treat the infection may also have caused anorexia and gastrointestinal disturbances such as diarrhea and nausea, which reduce protein and calore intake. Overall, albumin levels did not improve in the PD patients with the use of the nutrition supplements; however, levels did not significantly decline either.

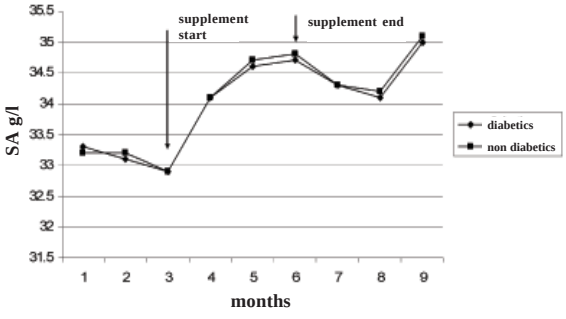

FIGURE 2 Serum albumin (SA) levels before, during, and after the nutrition supplement in dialysis patients with ("diabetics") and without ("non diabetics") diabetes.

Frequency of contact might influence the increase in compliance for use of the nutrition supplements and of foods needed to increase protein intake. Inpatient HD patients have frequent monthly contacts with the dietitian and other members of the patient care team. They have more opportunity for intensive and repeated counseling on protein intake by the dietitian, which helps to increase serum albumin levels. Apkele and Bailey showed that the rate of change in serum albumin was greater in patients who received intensive nutrition counseling than in those who received supplements (29). Leon *et al.* studied patient-specific barriers and observed statistical significance related to their intervention program for the barriers of poor knowledge about nutrition, help needed with shopping and cooking, and difficulty swallowing. Study coordinators educated patients using a variety of interactive materials about high-protein foods (30). The PD population may be in contact with the dietitian only at monthly scheduled visits, and so these patients do not receive reminders and education about increasing oral intake as frequently as the in-center HD population does. We also observed some differences in adherence to the use of the supplements: HD patients had greater adherence. Of the 33 PD patients in our study, 5 reported non adherence to the use of their nutrition supplements (not taking the supplement in a consistent manner). Of 157 HD patients, 13 reported non adherence to consumption of the supplement.

Patients on PD experiencing a feeling of fullness from the peritoneal dialysate in their abdomens may have been unable to consume a full meal and used the supplement only as a meal replacement or meal support. There may therefore have been no extra consumption of calories or protein. The liquid could have filled them up, leaving no room for solid foods.

Of the 33 patients, 5 used the powdered protein supplement (Procel); the other 28 used the oral liquid supplement. Higher concentrations of glucose in the peritoneal dialysate can lead to feelings of satiety that decrease intake. Boudville *et al.* suggested that oral supplements might lead to a reduction in intake at mealtimes through compensation or gastric filling (25). Ray (31) studied the use of Procel with PD patients and saw a decrease in serum albumin in patients with multiple comorbid conditions, hospitalizations, or infections, and an increase in serum albumin in patients with 5 or fewer comorbid conditions and no hospitalizations or infections. Procel prescriptions averaged 5 – 10 scoops daily (25 – 50 g protein). The prescription for our program was 6 scoops daily of powdered protein supplement providing 30 g protein, or 2 cans daily of liquid protein supplement providing 20 – 30 g protein daily depending on the supplement selected.

A subgroup of 5 PD patients in our study showed improvement in serum albumin at month 6, but their levels declined after the supplement period ended. Comments by the dietitians on the applications for these patients noted feelings of sadness and loss leading to depressed intake (2); multiple sclerosis, which may have made meal preparation difficult; exit-site infection; and history of reflux. These patients responded to the supplements and may have continued to show improvement in albumin level if the supplement was maintained daily. Our PD patients may have needed more protein than was provided by the program to achieve improvement in serum albumin to compensate for protein losses in cases of peritonitis. Because of the small number of patients, we did not analyze the PD data further.

Patients with diabetes showed improved albumin with the use of oral nutrition supplements. Diabetic patients in this observational study used liquid nondiabetic supplements, liquid diabetic supplements, or powdered protein supplement. Once the supplement supply was consumed, albumin levels remained improved. We compared the response in albumin level for diabetic patients with that for nondiabetic patients and found response to be similar.

Factors that can affect the calorie and protein intake of dialysis patients include difficulty in preparing foods, depression, tiredness after HD treatment, reduced intake because of time away from home on dialysis days, and missed meals. Disabilities have an affect on the intake of patients with dementia and stroke affecting the ability to eat, swallow, or prepare foods. Convenience in meals may be needed after dialysis. Nutrition supplements in the oral form provided a meal replacement for some people, and supplied additional protein and calories for others who were already eating meals.

Comorbid conditions present in the PD patients included diabetes, gastrointestinal disorders, and infection. Referral to the appropriate specialists for management of these conditions can help to resolve malnutrition. We did not track glycemic control or medications prescribed to these patients. Age is a non modifiable factor, and albumin synthesis is decreased in older adults. The large percentage of older dialysis patients with decreased activity levels may need additional interventions to help prevent and treat malnutrition.

Conclusions

Our study showed that nutrition supplements did not improve serum albumin levels or weight in PD patients. Patients on HD experienced a significant improvement in serum albumin, but no change in weight. Study patients with diabetes also had a significant improvement in serum albumin without a change in weight. These results confirm previous studies with similar results and add more information to help better understand the benefits and shortcomings of nutrition supplements in dialysis patients. Further studies are needed to explore the role of nutrition supplements in dialysis patients, focusing on outcomes and identifying specific types of supplements for particular subgroups of dialysis patients.

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