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Addition of physical assessment techniques to Subjective Global Assessment, to improve estimation of nutrition status in hemodialysis patients

Beth Ann Nichols
Iowa State University

Addition of physical assessment techniques to Subjective Global Assessment, to improve estimation of nutrition status in hemodialysis patients

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Beth Ann Nichols

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Program of Study Committee:
Mary Jane Oakland, Major Professor
Manju Reddy
Donald Beitz

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Graduate College
Iowa State University

This is to certify that the master's thesis of

Beth Ann Nichols

has met the thesis requirements of Iowa State University

Signatures have been redacted for privacy

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CHAPTER 1. GENERAL INTRODUCTION

Thesis Organization

This thesis contains a general introduction, a review of literature, one manuscript prepared for submission to a scientific journal, general conclusions, and appendices. The references cited in each chapter are listed at the end of the thesis using numeric citation style.

Introduction

There are a large number of patients on dialysis in the United States. In 2001, there were 476,954 people with End-Stage Renal Disease (ESRD) on dialysis. Of those, 37% had a primary diagnosis of diabetes, 24% hypertension, and 14% glomerulonephritis. In that same year, there were 72,680 deaths or a 15% mortality rate. Medicare payments for 2001 totaled $14 billion. This included all inpatient, outpatient, skilled nursing, home health, hospice, physician, and supplier charges (1). Medicare mandates that a registered dietitian provide nutrition services at each dialysis unit (2). Because this population is at high risk nutritionally and medically, it is important that a thorough nutrition assessment be performed to identify nutrition problems and adequate nutrition intervention be performed in the nutrition care process.

Dietitians may be able to improve nutrition assessment of hemodialysis patients by using detailed interviewing while conducting subjective global assessment (SGA) and nutrition-focused physical examinations. By using SGA and physical examinations routinely on all patients in the clinical setting, the practitioner is able to obtain an in depth and ongoing nutrition assessment. In the patient where objective measures such as weight, appetite, and albumin are normal, the physical examination may show frank muscle wasting. This additional information may then be used to pursue the appropriate nutrition or medical intervention.

Many times, detailed nutrition assessments in hemodialysis patients are limited to the initial contact with the patient. By performing assessments twice per year, data are available for comparison. SGA and physical assessment may help a clinician to identify nutritional problems earlier and more accurately than with traditional methods.

CHAPTER 2. LITERATURE REVIEW

Introduction

Patients with End-Stage Renal Disease (ESRD) on hemodialysis have complex nutritional needs with an increased risk for malnutrition due to the effects of kidney failure. Hemodialysis patients need to follow a special diet limited in sodium, potassium, and phosphorus. These limits coupled with the dietary changes to achieve these nutrient restrictions may contribute to the risk of malnutrition. Patients may have difficulty taking in adequate calories and protein to prevent weight loss and muscle wasting due to poor appetites, other medical conditions, and receiving multiple medications.

Morbidity and Mortality Rates for Hemodialysis Patients

The United States is often noted in literature as having lower survival rates when compared to European countries and Japan (3). In a study by Collins et al, the database for the Regional Kidney Disease program from 1976 to 1989 was reviewed, and identified several factors affecting the mortality of hemodialysis patients in the United States. There is a higher percentage of persons with diabetes on hemodialysis in the United States, which affects overall survival rates. However, when looking only at non-diabetic patients in the database, the patients still had a lower survival rate. Patients accepted for hemodialysis in the United States have shown an increase in risk factors, such as peripheral vascular disease, cardiac disorders, low albumin levels, and increased age. Non-diabetic hemodialysis patients over the age of 60 have increased 15-20 % per year. There was also an increase in the percentage of type II diabetics since 1982. The percentage of diabetics has nearly tripled from 12 % in the years 1976-1982, to 34% in the years 1986-1989 (3). Co-morbidity as single and multiple conditions increased to 85% from 66% in diabetic patients and to 66%

from 57% in non-diabetic patients (3). Patients with two or more co-morbid conditions increased two-fold in diabetic patients and 1.5-fold in nondiabetic patients from the 1976-1982 period to the 1986-1989 period (3). This study suggests that national databases may only offer a limited amount of information, since they do not include co-morbidities, nutrition status, or dialysis prescription, which all contribute greatly to overall patient survival on hemodialysis. In addition, acceptance rates of patients to hemodialysis and the changes in the distribution of type and number of diabetics should be considered. Other countries may have increased survival rates compared to the United States because they have low acceptance rates of diabetics or patients with multiple co-morbidities.

Lowrie and Lew used logistic regression analysis to evaluate patient descriptors, treatment time, and laboratory tests with the probability of death in > 12,000 hemodialysis patients (4). The results showed that advancing age, Caucasian race, diabetes, and short dialysis sessions were significantly associated with increased risk of death. Inadequate nutrition was found to be an important contributing factor influencing mortality risk in hemodialysis patients. Two-thirds of the patients had low serum albumin levels, and the greatest association with death was associated with an albumin level < 4.0 g/dl. Low serum creatinine was also associated with increased death risk. Longer dialysis session time was correlated with higher values of albumin and creatinine. Adequate dialysis therapy and maintaining adequate nutrition are both important factors in decreasing the risk of death for ESRD patients on hemodialysis.

The National Cooperative Dialysis Study (n=151) evaluated the effect of hemodialysis prescription of treatment length on patient morbidity (5). Patients were divided into four treatment groups according to treatment time (4.5 hours vs. 3 hours) and average blood urea nitrogen (BUN) concentration (90 mg/dl vs. 50 mg/dl) with respect to treatment time of 4.5 hours or 3 hours of hemodialysis. Dietary protein was not restricted. There was no difference in mortality between groups. There was increased morbidity with the dialysis prescription associated with high BUN levels (range 80 mg/dl after dialysis and 120 mg/dl before dialysis; mean 90 mg/dl). Dialysis treatment times that provide efficient removal of urea may decrease morbidity, as long as there is adequate dietary intake of protein and other nutrients (5).

Another study (n= 1,453) evaluating mortality risk factors in hemodialysis patients by Degoulet et al. (6), showed that body mass index (BMI) less than 20, low cholesterol (< 173 mg/dl) and low predialysis BUN (< 13 mg/dl) were associated with increased cardiovascular, stroke, and overall mortality. In addition to hypertension, poor nutritional state and/or low protein intake may contribute to the high cardiovascular and stroke mortality seen in hemodialysis patients (6).

A prospective cohort study (n=496) by Churchill et al. (7), found increased age and history of cardiovascular disease was independently associated with a greater probability of death among ESRD hemodialysis patients. An albumin level < 3.0 g/dl was associated with an increased probability of pulmonary edema and increased hospitalizations due to circulatory disease and infection (7).

A 26-month prospective nonintervention study by Herselman et al. (8), investigated the role of protein-energy malnutrition (PEM) as a risk factor for morbidity in patients on long-term hemodialysis (n=37). Morbidity was evaluated on the basis of the number of hospitalizations and days of hospitalizations per patient year. A PEM composite score was calculated from post dialysis serum albumin, arm muscle mass, fat mass, fat free mass, and

BMI. Morbidity, as defined by number of hospitalizations, showed a significant correlation ($p \leq 0.01$) with the mean and baseline PEM score. Infection was the diagnosis for 44 % of morbidity in the study, followed by cardiovascular disease (9%), gastrointestinal problems (9%), and problems with fistula other than infections (8%). The infection-related morbidity statistics showed a significant correlation with the mean PEM score ($p \leq 0.001$) and baseline PEM score ($p \leq 0.01$) (8).

Malnutrition is a complex, often overlooked condition in hemodialysis patients that may have normal laboratory values and appear to be stable. In one study, Acchiardo (9) evaluated the nutritional status of 98 hemodialysis patients and its role in their morbidity and mortality. Patients were stratified into four groups according to protein catabolic rate (PCR) and BUN levels. The group with the higher PCR and BUN levels had means of 1.2 g/kg/d and 96 mg/dl, respectively. Higher PCR and BUN levels correlated with a decline in hospitalizations and mortality rate. Hospitalizations were seen more frequently in the patients with lowest PCR (mean = 0.63 g/kg/d) and BUN (mean = 51 mg/dl). The two most common reasons or diagnoses for hospital stays in this group were infection and congestive heart failure. This group also had the highest mortality rate of 13.8% per year. The authors concluded that because risk factors were similar throughout all groups of patients, malnutrition was the main cause of the increased morbidity and mortality rates in the patients with the lowest PCR and BUN levels (9).

Energy and Nutrient Variations in ESRD

Pre-hemodialysis amino acid profiles were abnormal in hemodialysis patients as compared to control subjects (10). There was a significant decrease in amino acid profile levels for both essential and non-essential amino acids post-hemodialysis. Average albumin losses were 1.5 +/- 1.3 g/dialysis below the 15th reuse of high flux polysulfone dialyzers, and increased to 9.3 +/- 5.5 g/dialysis during the 20th reuse.

Rock et al. (11), found diabetes to be significantly associated with increased risk of vitamin B_6 deficiency in dialysis patients (n=105). Fourteen percent of all subjects had abnormal (≥1.25) erythrocyte glutamic pyruvic transaminase (EGPT) indexes, indicative of vitamin B_6 deficiency. Vitamin B_6 supplementation, dietary protein or vitamin B_6 intake, type of dialysis (hemodialysis vs. peritoneal dialysis), medication usage, gender, age, and ethnic group were not associated with or predictive of vitamin B_6 status.

In a study by Slomowitz et al, caloric needs of maintenance hemodialysis patients (n=6) were measured in order to determine whether maintenance hemodialysis patients have greater or lower than normal energy needs (12). The study included four men and two women in a controlled clinical research setting. The subjects were given diets providing 25, 35, and 45 kcal/kg of desirable body weight per day. Diets were provided in random order for 21-23 days each. Dietary protein of 1.13 ± 0.02 g/kg/day was provided in all three of the diets. The findings indicated that a calorie intake of 38 kcal/kg of desirable body weight may be needed to maintain positive nitrogen balance. Body weight, mid-arm muscle circumference, mid-arm muscle area and total plasma amino acid levels all increased with the 45 and 35 kcal/kg/d diets and decreased with the 25 kcal/kg/d diet. Relative body weight as compared to normal was decreased at the beginning of the study. Serum total protein and albumin were not abnormal. With the highest calorie level of 45 kcal/kg/d, total body fat increased. Nitrogen balance was positive with both the 35 and 45 kcal/kg/d diets. There was negative nitrogen balance and a decrease in body weight with the 25 kcal/kg/d diet. In addition, the serum albumin, total protein, cholesterol, creatinine, urea nitrogen, and hematocrit did not show variation with the different calorie level diets. Maintenance hemodialysis patients (MHD) may have greater energy requirements than they can meet with the level of calories they typically take consume (12). This study found that, although resting energy expenditure (REE), usually decreases when energy intake is decreased, in the patients in the study did not show this relationship.

In a study evaluating barriers to adequate protein nutrition (n= 298), Segal et al. found that overcoming barriers such as poor appetite, inadequate dialysis, co-morbid conditions, lack of knowledge regarding protein foods and providing assistance for cooking and shopping could improve patients' nutrition, survival, and number of hospitalizations (13).

Food records utilized for 9 days in stable hemodialysis patients showed no differences for dialysis days versus non-dialysis days (n=25) (14). Average calorie intake per day was 1656 ± 538 (range 795-2631). Average protein intake was 61.1 ± 17.2 g/day (range 29.3 – 97.6 g/day). Mean daily intakes of most water-soluble vitamins was below the recommended daily allowance (RDA). Vitamin B_6 and riboflavin had the most deficient intakes, 64% and 84% of the RDA respectively.

Kalantar-Zadeh et al. (15) used food frequency questionnaires to assess food intake differences between subjects receiving dialysis and subjects not receiving dialysis (n=60). Subjects on maintenance hemodialysis had significantly lower dietary intake of vitamin C, fiber, potassium, cryptoxanthin, and lycopene.

Twenty-four hour dietary recall interviews were compared with a semi-quantitive food frequency questionnaire in 40 chronic renal failure patients in Holon, Israel (16). The food frequency questionnaire consistently had higher reported intakes as compared to the 24-hour recall. Boaz et al., (16) found of the nutrients measured (energy, protein, total fat, saturated fat, polyunsaturated fat, cholesterol), all means except cholesterol were significantly different (expressed as mg/kcal) from the 24-hour recall as compared to the food frequency questionnaire.

In a study (n=298) by Ohri-Vachaspati (17) the authors found that appetite correlated with dietary protein intake and energy intake. They also found that, although hemodialysis patients may have poor overall appetite, they may have a good appetite for specific foods.

Nutrition Assessment

Prealbumin (serum transthyretin) has been shown to be a valid indicator to identify malnutrition in hemodialysis patients (n= 51) (18). However, this measure is not widely available for use by clinicians due to lack of reimbursement. Another method of assessing nutrition status is anthropometrics. Measurements such as mid-upper arm circumference (MAC), mid-upper arm muscle circumference (MAMC), and tricep skinfold thickness may not be the best tools to utilize in dialysis patients because of fluid retention. From a practice standpoint, obtaining these parameters in the dialysis population may be prohibitive due to time and effort required for performing the measurements accurately. Instead of evaluation of these measurements as they relate to a standard scale, it is important to consider the amount of change in measurement experienced by the individual patient to help assess overall nutritional status (19). A patient would need to experience a 2.68 cm change in arm circumference and tricep skinfold thickness in order to show a change in category on the standard scale (19). Therefore, if a patient was in the upper range of normal, they are still classified as normal even though there was a decrease in measurement of arm circumference and tricep skinfold thickness (19).

Objective measurements such as albumin, transferrin, and delayed cutaneous hypersensitivity can be widely influenced by disease states. Baker et al. showed that general clinical assessment, which included history taking and physical examination, was a reproducible and valid technique for evaluating nutritional status in 59 elective surgery patients (20).

Subjective Global Assessment and Physical Examination

Diabetic hemodialysis patients are often overweight (BMI > 25). In a cross-sectional study by Biesenbach et al., nutrition parameters in patients with type 2 diabetics were compared with age-matched, dialysis patients without diabetes after 18 months of hemodialysis (n=30) (21). The nutrition parameters included BMI, albumin, total protein, cholesterol, interdialytic fluid gain, Subjective Global Assessment, PCR, and KT/V (a measure of adequacy of dialysis therapy). The results showed that BMI was significantly higher (30 ± 7 vs. 24 ± 3, $P<0.01$) and serum albumin was significantly lower (3180 ± 499 mg/dl vs. 3576 ± 431 mg/dl, $P<0.05$) in diabetics than non-diabetics. Other nutritional parameters measured did not differ between the two groups. Six of the diabetic patients were noted to have signs of chronic inflammation. The low serum albumin concentration in these diabetic patients therefore may have been related to subclinical chronic inflammation (21).

Interrater variablility and validity of SGA in Swedish elderly subjects (n=90) over age 70 was evaluated by Ek et al. (22). Subjects were assessed by two independent observers using SGA with anthropometry and serum protein measurement. There was a 78 % agreement between the two examiners, one examiner was more experienced that the other examiner. Weight, MAMC, and tricep skinfold thickness were significantly different between well nourished and malnourished subjects ($p \leq 0.001$). Albumin and prealbumin were not statistically different (22).

A study by Bilbrey et al. (23), reviewed parameters used to diagnose protein calorie malnutrition in chronic hemodialysis patients (n=204). Seven of the eight parameters (physical examination, tricep skinfold thickness, mid-arm circumference, mid-arm muscle circumference, albumin, transferrin, and total lymphocyte count) showed a significant correlation with a malnutrition index score. The only parameter that did not was the weight to height ratio. However, the actual weight of patients did show a significant negative correlation with the malnutrition index. A small significant negative correlation of BUN with the malnutrition index was found. Albumin and transferrin were not significantly different among the distribution of patients rated as severely malnourished to not malnourished (23).

Stenvinkel et al., found a strong association between malnutrition, inflammation, and atherosclerosis in 109 renal failure patients not yet receiving dialysis (glomerular filtration rate 7 ± 1 ml/min) (24). Dual-energy x-ray absorpitometry (DXA), SGA, serum albumin, serum creatinine, urea, and 24-hour urine urea excretion, were assessed for nutritional status. Fibrinogen, C-reactive protein (CRP), and tumor necrosis factor were assessed for inflammation. Malnourished subjects (as rated by SGA), had significantly lower BMI, serum creatinine, serum albumin, and urine urea excretion (24). Blood urea nitrogen was not significantly different between well-nourished and malnourished subjects. Body composition, as analyzed by DXA, showed significantly lower lean body mass in the malnourished subjects. Subjects with elevated CRP had a high prevalence of malnutrition (SGA rated) and significantly lower albumin concentration. Carotid duplex data showed malnourished subjects had significantly increased mean intima-media thickness and mean calculated intima-media area compared to that of the well-nourished subjects. The prevalence of subjects with atherosclerotic cardiovascular disease and carotid plaques were both significantly elevated among the malnourished subjects.

Subjective global assessment has been compared to inexpensive laboratory parameters such as total iron binding capacity (TIBC), serum transferrin saturation, serum iron, ferritin, hemoglobin, creatinine, albumin, total protein, total cholesterol, and urea reduction ratio (URR) (25). The study included 59 hemodialysis patients. Subjective global assessments were conducted twice, once by a physician (trained in SGA by a dietitian) and a second time by a dietitian. Transferrin (as assessed by TIBC) correlated directly with the state of nutrition. The lower the transferrin, the poorer the patient's nutrition rating by SGA. Albumin levels were significantly lower in group C (poorly nourished) as compared to groups A (well nourished) or B (moderately nourished). The study suggests that, although albumin is helpful in predicting severe malnutrition, it may miss mild or moderate malnutrition (25). Cholesterol and total protein were no better than albumin for predicting nutrition status. Ferritin concentration was significantly higher in group C. Dialysis adequacy, creatinine, hemoglobin, hematocrit, mean corpuscular volume (MCV), serum iron, epoetin alfa (EPO) dose, and transferrin saturation were not significantly different. Serum iron was lowest in the poorly nourished patients (group C). Group C generally received higher EPO doses. Transferrin saturation was slightly higher in group C, which was the opposite of what was expected. The study shows that there is a strong independent relationship between TIBC and the severity of malnutrition. Subjective global assessment showed a very significant, direct correlation with serum TIBC. Subjective global assessment also correlated with albumin, serum iron, EPO dose, but inversely correlated with ferritin.

Subjective global assessment has been found to be an effective and inexpensive method of nutrition assessment (26). A study by Detsky et al (1987), found that the characteristics with the largest correlation coefficients to SGA were weight loss, muscle wasting, and loss of subcutaneous fat (n=202). Subjective global assessment is a method that can be taught to several clinicians and still have a high rate of similarity when assigning ratings. This study showed that there was 91% agreement between interviewers performing SGA.

Cianciaruso et al. (27), showed that for hemodialysis and peritoneal dialysis patients (n=487) whom were rated as malnourished by SGA had significantly lower serum total protein, albumin, transferrin, and relative/desirable body weights. MAMC, subscapular, tricep, bicep, and suprailliac skinfold thickness and estimated body fat % showed lower trends in the hemodialysis and peritoneal patients classified as malnourished by SGA (27).

One-hundred seventy-five non-ESRD patients admitted to a medical surgical gastrointestinal service were evaluated first by a dietitian performing a clinical assessment (28). The clinical assessment included anthropometric measures such as height, weight, MAC, and tricep skinfold thickness. Laboratory measures included albumin, hematocrit, and prothrombin time. Within 24 hours of the clinical assessment, SGA was performed once by a first-year resident and a second time by a specialist in clinical nutrition. The examiners performing SGA were not aware of the initial clinical assessment by a dietitian or the anthropometric or laboratory data. There was a 79% agreement of the SGA ratings between the resident and clinical nutrition specialist. Subjects rated in the three categories (well nourished, moderately undernourished, or severely undernourished) had significantly different weight, MAC, tricep skinfold thickness, and serum albumin levels ($p \leq 0.001$).

Kalantar-Zadeh et al. used a modified quantitative SGA rating system with expanded scoring of 1 (normal) to 5 (severe) for seven categories: weight change, dietary intake, gastrointestinal symptoms, functional capacity, co-morbidity, subcutaneous fat stores, and signs of muscle wasting (29). The total score from the seven categories was rated as 7 (normal) to 35 (severely malnourished). The modified quantitative SGA system was compared to conventional SGA method. Anthropometrics included MAC, MAMC, and triceps skinfold thickness. Additional measurements included BMI and laboratory measures such as albumin, total protein, cholesterol, triglyceride, total iron binding capacity to estimate transferrin, serum iron, iron saturation, ferritin, creatinine, BUN, URR, and PCR. The dietitian performing the SGA interviews had no knowledge of the anthropometric or laboratory results. Conventional SGA correlated significantly with transferrin ($p \leq 0.023$) and MAMC ($p \leq 0.017$). The modified SGA with a total malnutrition score was significantly correlated with transferrin, serum albumin, total protein, MAC, MAMC, biceps skinfold thickness, BMI, age, and years on dialysis (29). This study concluded that the modified quantitative SGA rating system, which was performed in minutes, reliably assessed the nutrition status of hemodialysis patients and may be superior to conventional SGA (29).

Examining the nails of hemodialysis patients is an inexpensive and non-invasive method of screening for nutritional deficiencies. Examination of the nails can provide direction for clinicians to follow in order to correct possible deficiencies (30). Iron and protein deficiency may be found in hemodialysis patients. Careful physical examination and laboratory documentation of vitamin and mineral status at University of California Renal

Center suggested clinically significant micronutrient imbalance in roughly one third of the hemodialysis patients examined. In addition to nails, further physical examination of the hands can show interosseous muscle wasting, cartenoderma, palmar erythema, and Dupuytren's contractures (30).

A case study by Kelly et al. (31), demonstrated the use nutrition physical examination of angular stomatitis, mild lip desquamation with ecchymotic-like lesions, seborrheic-like dermatitis or the scalp or eyebrows, dry flaky skin with sparse, wiry hair and scattered corkscrew and swan-neck hairs, and somatic wasting and peripheral nephropathy (31). The case study involved a very ill patient who had experienced weight loss, overall extreme weakness, low cardiac ejection fraction, and drug treatment isoniazid (INH) for tuberculosis. Physical examination showed many clinical signs of vitamin and mineral imbalance. The subject's diagnosis of B_6 toxicity and zinc deficiency was confirmed with laboratory testing. Zinc supplementation was added at 50mg of elemental zinc per day and the B_6 supplement was discontinued for a 3-month period. Mouth, skin, and hair changes resolved dramatically, and in three months the patient's weight returned to normal. Steps were taken to improve dialysis adequacy to reverse uremic cardiomyopathy(31).

A study by Enia et al. (32) compared subjective global assessment with objective measurements such as skinfold thickness, mid-arm muscle circumference, bioelectrical impedance, and biochemical measurements in 59 chronic hemodialysis patients (32). All of the measurements, including weight, albumin, MAMC, % fat, nutritional protein catabolic rate, independent of gender and treatment modalities, were significantly better in well-nourished dialysis patients than in the entire group of malnourished dialysis patients (32). The mean age for the malnourished group was 63.3 years compared with 50.8 years for the well nourished group (32). The study also noted that weight loss alone can be misleading, since the loss of lean body tissue may be masked by retaining fluid.

Assessment of malnutrition as measured by upper arm anthropometry and bioelectrical impedance showed that, on average, 33% of ESRD subjects with muscle mass less than 90% of predicted had a normal serum albumin concentration (33). Subjects were on either hemodialysis or peritoneal dialysis (n=134). Nineteen percent of subjects had a serum albumin concentration less than 35 g/L. Among hypoalbuminemic subjects, 9% had a normal muscle mass content.

Laws et al., assessed nutritional status in chronic hemodialysis patients (n=53) using SGA, anthropometric measures (TSF, MUAC), and biochemical measures (albumin, transferrin) (34). Quality of life was assessed by questionnaire and assessment of physical functioning. Thirteen percent of patients were rated as severely malnourished, 23 % moderately malnourished, and 64 % well-nourished. Malnutrition was associated with reduced quality of life after adjustment for the effects of socio-demographic and medical variables. Severe malnutrition was independently associated with poorer physical function and resulted in significantly more hospital admissions, days of hospitalization, and increased length of hospital stays (34).

In 2000 the SGA format was recommended by Kidney Disease Outcomes Quality Initiative (KDOQI) (35) to be performed as an assessment tool for all dialysis patients twice per year. Currently, the 7-point scale (severely malnourished to well nourished) using the four categories of weight loss, anorexia, subcutaneous fat, and muscle mass is suggested. The bromcresol green method for albumin is preferred to be used for chronic renal failure patients, with a goal of 4.0 g/dl (35). The clinical practice guidelines for nutrition in chronic renal failure note that the presence of acute or chronic inflammation limits the specificity of serum albumin as a nutritional marker (35).

CHAPTER 3. ADDITION OF PHYSICAL ASSESSMENT TECHNIQUES TO SUBJECTIVE GLOBAL ASSESSMENT, TO IMPROVE ESTIMATION OF NUTRITION STATUS IN HEMODIALYSIS PATIENTS

A paper to be submitted to the Journal of Renal Nutrition

Beth Ann Nichols

Abstract

Thirty-nine hemodialysis patients over the age of 18 were interviewed and assessed by one registered dietitian using subjective global assessment (SGA) and nutrition-focused physical examination. An overall nutrition rating based on a seven-point scale of 1-2=severely malnourished, 3-5 moderate to mildly malnourished, and 6-7 well nourished was assigned. Depending on the assessment, a nutrition intervention may have been implemented. The same patients were assessed again using the same technique six months later. The overall nutrition rating and subjective estimates for bicep fat stores, under eye fat stores, triglyceride, leg muscle, temporal muscle, and creatinine all improved from the initial assessment to the second assessment. Patients with a lower overall nutrition rating had a higher rate of receiving nutrition interventions. Univariate analysis of variance was used to compare the three nutrition rating categories to body mass index (BMI), weight, albumin, cholesterol, triglyceride, transferrin, hemoglobin, hematocrit, blood urea nitrogen (BUN), creatinine, and nutrition intervention. For both the initial nutrition assessment and second nutrition assessments, only BMI, weight, and presence of nutrition intervention correlated with the nutrition rating category. Those patients in the lowest nutrition rating category had the lowest body weight and BMI, and had the highest incidence of nutrition intervention.

Serum albumin was not significantly different among the groups of patients in the severely malnourished, moderate to mildly malnourished or well nourished SGA nutrition

rating categories. This shows that SGA and nutrition-focused physical examination may provide a more specific and accurate nutrition assessment than relying solely on serum albumin concentrations.

Introduction

It is important to be able to screen patients with End-Stage Renal Disease (ESRD) effectively for nutrition status, as malnutrition is related to increased risk of morbidity and mortality (4,6). If a screening method is not sensitive enough to detect malnutrition (such as albumin), then the patient may have a marked decline in status before it is noted, at which point, the patient is at a disadvantage both nutritionally and medically.

Subjects with ESRD are a special population and dietitians need a tool that helps identify those at risk. Subjective Global Assessment (SGA) has been shown to be a valid and reproducible method for assessing nutritional risk (20,22). In addition to SGA, physical examination of a patient's skin, hair, nails, eyes, subcutaneous fat, and muscle stores provide valuable information. (30, 31). This method is also inexpensive and quickly performed by a trained practitioner. Combining SGA and nutrition-focused physical exam with traditional nutrition assessment methods such as BMI, dietary history, and laboratory measures (albumin, transferrin, and cholesterol) may provide a more sensitive and comprehensive nutrition assessment in subjects on hemodialysis.

Methods

Thirty-nine hemodialysis patients who had received dialysis through one dialysis center for at least three months were selected for the study. Informed consent was obtained from each subject (Appendix A). A SGA and nutritional physical assessment form (Appendix B) was used for nutrition interview and assessment. One trained registered dietitian conducted an interview and performed a nutrition-focused physical examination on each patient. The SGA interview and physical assessment took approximately 15 minutes to perform for each subject. The interview portion included questions regarding appetite and presence of gastrointestinal (GI) symptoms that interfere with eating or appetite such as nausea, vomiting, diarrhea, constipation, anorexia, altered taste or smell, mouth sores, dry mouth, and pain. Subjects were also questioned about their current activity level, including if it was the same as usual, better than usual, or lower than usual.

Appetite was evaluated by utilizing three categories of poor, fair, and good. Skin, eye, and nail condition and GI symptoms were evaluated as 0 = absence of problem and 1 = abnormality noted.

The examination included the evaluation of skin on the face and lower limbs, eye condition for moisture, redness, presence of lesions and condition of tissue around the eye, and nail condition for nail plate color, nail bed color, texture of nail plate, and condition of tissue around the nail. Fat stores were evaluated by examining the under eye fat pad, and subcutaneous fat layer over the tricep and bicep muscles. Somatic muscle stores were evaluated by examining the temporal area, interosseous muscle, clavicle, lower leg, upper arm, and fit of prostheses (if applicable). A seven-point scale of 1-2 = severely malnourished, 3-5 = moderate to mildly malnourished, 6-7 = well nourished was used to assign a rating to each of the following attributes: under eye fat pad, tricep fat stores, bicep fat stores, temporal area, interosseous muscle, clavicle, lower leg muscle, and upper arm muscle. An overall rating (using the same seven-point scale) for SGA and physical examination was assigned for each subject. A nutrition assessment, nutrition intervention, and follow-up plan were included in the medical chart note, along with objective measures such as weight, weight one month ago and six months ago, % weight change, BMI, serum calcium, albumin, phosphorus, and potassium. The laboratory data included in this study was routinely ordered by physicians in the dialysis unit and the laboratory analyses were performed by the respective laboratories (39, 40, 41). The laboratory results utilized in this study were from the dates closest to the initial and second nutrition assessment dates. A nutrition intervention was implemented to address nutrition problems identified. Nutrition interventions included nutritional supplement products for added calories and protein and counseling the subject to increase calories and/or protein in their diet. Nutrition intervention was evaluated by reviewing the SGA and physical assessment notes. The interventions were arranged for analysis as 0= "No intervention needed", 1= "no intervention, subject has been nutritionally stable", 2= "Intervention". A second interview and nutrition-focused physical examination was performed on each subject six months later.

The Kidney Disease Outcomes Quality Initiative (KDOQI) clinical practice guidelines (35) for nutrition in chronic renal failure recommend that SGA be performed using a 4-item, 7-point scale (severely malnourished to well nourished). The four items are: body weight change over the past six months, dietary intake, GI symptoms, and visual assessment of subcutaneous tissue and muscle mass (35). For this study, SGA was expanded with the addition of BMI and upper arm muscle and nail, skin, and eye abnormalities.

Statistics were analyzed using SPSS version 11.0 (42). For the purpose of analysis in some cases, the overall SGA nutrition rating using the seven-point scale was condensed to three categories of severely malnourished (1-2), moderate to mildly malnourished (3-5), and well nourished (6-7). The specific physical attribute scoring for muscle and fat stores of each subject remained in the seven-point scale format.

Results

The subjects in this study (n= 39) included 18 males and 21 female hemodialysis patients. Greater than one-third of the subjects had diabetes as either primary or secondary diagnosis for ESRD. The average age was 61 years (range 31-94 years). The average length of time on dialysis was 4 years (range 3 months -29 years). Twenty-nine subjects were Caucasian, eight subjects African American, and two subjects Hispanic (non-white). The primary medical diagnoses related to developing ESRD are listed in Table 1.

The overall nutrition rating for the 7-point scale and 3-point scale for nutrition status improved from the initial SGA and physical nutrition assessment to the second SGA and physical nutrition assessment ($p \leq 0.000$, $p \leq 0.003$) for subjects in which a nutrition intervention was implemented (n=15). Four physical examination estimates of bicep fat stores, under eye fat stores, lower leg calf muscle, and temporal muscle all showed significant positive improvement in subjects from initial assessment to the second assessment ($p \leq 0.003$, 0.010, 0.032, 0.045 respectively). Serum albumin did not show improvement from the initial assessment to the second assessment ($p \leq 0.101$). Skin condition, which could include presence of dry skin, was not improved at the time of the second nutrition assessment ($p \leq 0.001$). Paired t-tests on laboratory measures, BMI, SGA and physical examination attributes, and presence of a nutrition intervention were performed and are listed in Table 2.

Table 1. Primary Diagnosis for Development of ESRD in Study Subjects (n=39)

Primary Diagnosis for Subjects	Subjects
Diabetes	11
Hypertension	9
Polycystic kidney disease	4
Chronic obstructive uropathy	2
Focal glomerulosclerosis	2
Glomerulonephritis	2
Cholesterol emboli	1
Drug toxicity	1
Goodpasture's syndrome	1
Lupus erythematosus	1
Prolonged antibiotic therapy	1
Renal artery stenosis	1
Streptococcal glomerulonephritis	1
Traumatic/Surgical loss of kidney	1
Unknown etiology	1

Table 2. Comparison of Initial and Second Nutrition Assessment Results (paired t-test) for Subjects in which a Nutrition Intervention was Implemented (n=15)

Variable	Mean(pre)	Mean(post)	p-value ≤ .05
Overall nutrition rating*	3.2	4.7	0.000
Skin condition	0.2	0.7	0.001
Overall nutrition rating 2†	1.7	2.3	0.003
Bicep (fat stores)	3.3	4.4	0.003
Under eye (fat stores)	4.2	5.1	0.010
Serum triglyceride mg/dl	113.1	166.0	0.025
Leg (calf muscle)	3.7	4.6	0.032
Serum creatinine mg/dl	8.2	9.3	0.042
Temporal muscle	4.1	4.8	0.045
Nutrition intervention	2.0	1.7	0.055
Clavicle	4.1	4.9	0.060
Interosseous muscle	4.5	5.3	0.082
Serum albumin g/dl	3.5	3.7	0.101
Tricep (fat stores)	4.0	4.6	0.144
Body mass index	22.8	23.3	0.148
Eye condition	0.3	0.5	0.189
Serum transferrin mg/dl	188.1	173.4	0.207
Body weight (kg)	64.5	65.5	0.225
Upper arm muscle	4.1	4.7	0.229
Activity level	1.9	2.2	0.301
Serum cholesterol mg/dl	145.9	149.1	0.732
Appetite	2.2	2.3	0.827
Hemoglobin g/dl	11.3	11.4	0.896
BUN mg/dl	58.0	58.7	0.905
Hematocrit %	33.9	33.9	0.996
Nail condition	0.8	0.8	1.000
GI symptoms	0.5	0.5	1.000

* based on 1-7 point scale

† based on a 1-3 point scale

Initial Nutrition Assessment Descriptive Results

Tables 3 and 4 show descriptive data for the number of subjects in each of the overall nutrition assessment ratings according to SGA and physical examination attribute scoring, and implementation of a nutrition intervention.

Fifty-one percent of all subjects had GI symptoms. Three were severely malnourished, 10 were mild to moderately malnourished, and seven were in the well nourished category. Appetite ratings were variable, as there were some subjects that reported good appetites in the severely malnourished category and some subjects in the well nourished and moderately to mildly malnourished categories reported poor appetites. Seventy-seven percent of all subjects had nail abnormalities. Five of those were severely malnourished, 19 were mild to moderately malnourished, and six were well nourished. Thirty-six percent of all subjects had skin abnormalities. Two were in the severely malnourished category, eight were mild to moderately malnourished, and four were well nourished. Forty-one percent of all subjects had eye abnormalities. Three were severely malnourished, nine were mild to moderately malnourished and four were well nourished. Activity levels were less than usual for 21% of subjects. Three were severely malnourished, four were mild to moderately malnourished and one was well nourished.

Distribution of subjects within the overall nutrition ratings for interosseous muscle, clavicle, upper arm muscle, leg muscle, temporal muscle, bicep fat stores, tricep fat stores, and under eye fat stores all have a similar pattern where the subjects with low scores for physical attributes also were in the severely malnourished category. Subjects in the mild to moderately malnourished category were more heavily distributed higher on the 7-point scale,

Table 3. Descriptive Data for the Initial Assessment Distribution of Subjects for SGA Rating Categories, Physical Examination Attributes and Nutrition Intervention* (n=39)

SGA Rating		Severe n=6	Moderate/Mild n=23	Well n=10
Appetite	poor		4	1
	fair	3	7	
	good	3	12	9
GI symptoms	no	3	13	3
	yes	3	10	7
Nail abnormalities	no	1	4	4
	yes	5	19	6
Skin abnormalities	no	4	15	6
	yes	2	8	4
Eye abnormalities	no	3	14	6
	yes	3	9	4
Activity level	less	3	4	1
	same	3	14	6
	better		5	3
Interosseous muscle	2	2	1	
	3	2	2	
	4	1	7	
	5		6	1
	6		6	5
	7	1	1	4
Clavicle	2	3	1	
	3		1	
	4	2	5	
	5	1	6	
	6		7	5
	7		3	5
Upper arm muscle	2	1		
	3	2	2	
	4		10	1
	5	1	7	3
	6	2	4	4
	7			2
Leg muscle	2	3	1	
	3	3	1	
	4		7	
	5		8	2
	6		6	5
	7			3

Table 3. (continued)

Temporal muscle	2	3		
	3	1	1	
	4	2	5	
	5		9	3
	6		7	4
	7		1	3
Bicep fat stores	1	1		
	2	3	2	
	3	2	3	
	4		7	1
	5		10	2
	6		1	3
	7			1
Tricep fat stores	2	1		
	3	4	4	
	4	1	4	1
	5		7	1
	6		7	4
	7			1
Under eye fat stores	2	1		
	3	2	1	
	4	2	6	
	5	1	9	2
	6		5	4
	7		2	4
Nutrition intervention	0		4	9
(3-point SGA scale)	1		11	
	2	6	8	1

SGA Rating		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nutrition intervention	0					4	6	3
(7-point SGA scale)	1			1	3	7		
	2		6	3	4	1	1	

* Nutrition rating categories of Severely Malnourished (1-2), Moderately to Mildly Malnourished (3-5), and Well Nourished (6-7)

at approximately a level of "4" or higher for each attribute. Subjects in the well nourished category generally had even higher physical attribute scores.

The nutrition intervention is listed in Tables 3 and 4, showing both the three-point and seven-point category ratings for nutrition status. In order to show the most detail, the seven-point category results will be discussed here. The nutrition intervention shows that all six subjects that were severely malnourished had a nutrition intervention. Three out of four subjects rated as a "3" (mild/moderately malnourished) had a nutrition intervention. Four out of seven subjects rated as a "4" (mild/moderately malnourished) had an intervention. One out of 12 subjects rated as a "5" (mild/moderately malnourished) had an intervention. One subject out of seven rated as a "6" (well-nourished) had an intervention, and zero out of three subjects ranked as a "7" required an intervention.

Second Nutrition Assessment Descriptive Results

Only one subject on the second nutrition assessment was rated as severely malnourished. Second nutrition assessment ratings of appetite showed that the one subject rated in the severely malnourished category also had a poor appetite. Thirty-eight percent of the subjects in the mild/moderately malnourished category had either a poor or fair appetite. Fifty-five percent of the subjects rated as well nourished reported a good appetite. Forty-nine percent of all subjects had GI symptoms. One subject was in the lowest nutrition rating, seven in the mild/moderate category, and eleven that were well nourished. Seventy-two percent of all subjects had nail abnormalities. One subject in the severe category, 12 in the mild/moderate category, and 15 in the well nourished rating. Fifty-six percent of all subjects had skin abnormalities. One subject was severely malnourished, thirteen in the mild/moderate category, and eight that were well nourished. Forty-nine percent of all

Table 4. Descriptive Data for the Second Assessment Distribution of Subjects for SGA Rating Categories, Physical Examination Attributes and Nutrition Intervention * (n=39)

SGA Rating		Severe n=1	Moderate/Mild n=16	Well n=22
Appetite	poor	1	2	2
	fair		4	8
	good		10	12
GI symptoms	no		9	11
	yes	1	7	11
Nail abnormalities	no		4	7
	yes	1	12	15
Skin abnormalities	no		3	14
	yes	1	13	8
Eye abnormalities	no		9	11
	yes	1	7	11
Activity level	less		6	5
	same	1	7	9
	better		3	8
Interosseous muscle	2	1		
	3		7	
	4		1	2
	5		4	2
	6		2	7
	7		2	11
Clavicle	2	1	2	
	3		1	
	4		5	3
	5		3	3
	6		4	7
	7		1	9
Upper arm muscle	2		1	
	3	1	4	
	4		6	3
	5		1	5
	6		3	9
	7		1	5
Leg muscle	2	1	2	
	3		3	
	4		2	2
	5		2	6
	6		6	9
	7		1	5

Table 4. (Continued)

Temporal muscle	2		1	
	3	1	1	1
	4		6	3
	5		6	3
	6		2	8
	7			7
Bicep fat stores	2	1	1	
	3		1	
	4		8	3
	5		5	5
	6		1	8
	7			6
Tricep fat stores	2	1	1	
	3		2	
	4		4	4
	5		8	3
	6		1	6
	7			9
Under eye fat stores	3	1	3	
	4		3	1
	5		5	3
	6		5	6
	7			12
Nutrition intervention (3-point SGA scale)	0		2	13
	1		5	4
	2	1	9	5

SGA Rating		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nutrition intervention (7-point SGA scale)	0					2	9	4
	1				2	3	4	
	2		1	2	5	3	4	

* Nutrition rating categories of Severely Malnourished (1-2), Moderately to Mildly Malnourished (3-5), and Well Nourished (6-7)

subjects had eye abnormalities. One subject in the severe category, seven in the mild/moderate, and 11 were well nourished. For activity, the only subject that was severely malnourished rated his/her activity as the "same as usual", whereas eight out of 11 respondents in the well nourished category stated "better than usual" activity.

Interosseous muscle, clavicle, upper arm muscle, leg muscle, temporal muscle, bicep fat stores, tricep fat stores, and under eye fat stores in the second nutrition assessments follow the same general pattern that occurred as noted previously for the initial nutrition assessments. Those subjects with higher physical attribute scores also tended to have higher overall nutrition ratings.

The nutrition intervention on the second nutrition assessment shows that the one subject that was severely malnourished had a nutrition intervention. Both of the subjects (2) rated as a "3" (mild/moderately malnourished) had an intervention. Five out of seven subjects rated as a "4" (mild/moderately malnourished) had an intervention. Three out of eight subjects rated as a "5" (mild/moderately malnourished) had an intervention. Four subjects out of 17 rated as a "6" (well nourished) had an intervention and zero out of four subjects ranked as a "7" required an intervention.

Univariate analysis of variance of initial assessment overall nutrition ratings as reported in Table 5 showed that nutrition intervention ($p \leq 0.000$), BMI ($p \leq 0.001$), and weight ($p \leq 0.009$) showed significant differences between the initial SGA nutrition rating categories of severely malnourished, moderately to mildly malnourished and well nourished. BMI and body weight were lowest in the severely malnourished category and highest in the well nourished category. Laboratory measures such as albumin, cholesterol, triglycerides,

Table 5. Univariate Analysis of Variance of Severely Malnourished (1-2), Moderately to Mildly Malnourished (3-5) and Well Nourished (6-7) to Laboratory Measures, BMI, Weight, and Nutrition Intervention from Initial Overall SGA Ratings n=39

Dependent Variable	p-value ≤ .05	Severe n=6	Moderate/ Mild n=23	Well n=10
Intervention	0.000	2.0	1.2	0.2
Body mass index	0.001	22.0	25.3	32.3
Body weight (kg)	0.009	59.7	71.5	89.2
Triglyceride mg/dl	0.071	117.0	146.8	224.1
Transferrin mg/dl	0.138	188.0	182.0	211.0
Hemoglobin g/dl	0.203	10.7	11.7	11.7
BUN mg/dl	0.271	53.3	60.8	50.9
Creatinine mg/dl	0.465	7.7	9.3	9.3
Albumin g/dl	0.468	3.5	3.6	3.7
Hematocrit %	0.480	32.9	35.1	34.9
Cholesterol mg/dl	0.629	144.7	159.0	159.3

hemoglobin, hematocrit, blood urea nitrogen, creatinine, and transferrin did not show any significant differences when compared against the initial SGA overall nutrition rating.

Univariate analysis of variance as reported in Table 6 showed that, for BMI ($p \leq 0.003$), body weight ($p \leq 0.004$), and nutrition intervention ($p \leq 0.009$), there were significant differences between the second SGA nutrition rating categories. Similarly, BMI and body weight values increased as nutrition ratings increased from severely malnourished to moderate/mildly malnourished to well nourished. Laboratory measures such as albumin, cholesterol, triglycerides, hemoglobin, hematocrit, blood urea nitrogen, creatinine, and transferrin did not show any significant differences when compared against the overall SGA nutrition rating for the second nutrition assessment.

Table 6. Univariate Analysis of Variance of Severely Malnourished (1-2), Moderately to Mildly Malnourished (3-5) and Well Nourished (6-7) to Laboratory Measures, BMI, Weight, and Nutrition Intervention from Second Overall SGA Ratings n=39

Dependent Variable	p-value ≤.05	Severe n=1	Moderate/ Mild n=16	Well n=22
Body mass index	0.003	17.6	23.3	29.3
Body weight (kg)	0.004	50.5	63.7	83.8
Intervention	0.009	2.0	1.4	0.6
Albumin g/dl	0.122	3.9	3.6	3.8
Cholesterol mg/dl	0.292	114.0	140.0	154.7
BUN mg/dl	0.343	36.0	53.8	59.6
Triglyceride mg/dl	0.444	136.0	139.9	182.1
Hemoglobin g/dl	0.580	10.4	11.3	11.6
Hematocrit %	0.621	30.9	33.7	34.3
Transferrin mg/dl	0.750	184.0	166.3	174.1
Creatinine mg/dl	0.979	10.0	9.4	9.5

Discussion

The paired t-test results in Table 2 showed that both the 3-point and 7-point scale ratings for nutrition status improved from initial assessment to the second assessment. This would be logical, because as nutrition problems are found in a population and nutrition interventions implemented, the goal would be to find improvement if the same subjects are evaluated six months later. Bicep fat stores, under eye fat stores, and leg (calf) muscle, and temporal muscle also improved from initial assessment to the second assessment. This trend may be expected since overall nutrition ratings also improved. Serum creatinine also was improved at the time of the second nutrition assessment. This could reflect an increase in muscle mass in these subjects. Serum triglyceride concentration was significantly improved, which could reflect overall improved nutrition status or could be due to variations in subjects depending on the use of lipid lowering medications, which was not evaluated in this study. Skin condition showed a higher mean, showing a higher rate of abnormality, at the second nutrition assessment (0.7 vs. 0.2 at the initial assessment). Abnormal skin condition could have included dry skin, which is not unusual in dialysis patients, skin lesions, or skin ulcers. There were very few patients with skin lesions or ulcers and a higher rate of those with dry skin. Serum albumin was not significantly changed from the initial nutrition assessment to the second nutrition assessment in those subjects that required an intervention. This shows that for subjects that were deemed nutritionally at risk by SGA and physical examination, the serum albumin concentrations were not good indicators for nutrition screening, when identifying patients at risk, or for monitoring response of nutrition interventions to improve diet quality.

The descriptive data for initial nutrition assessment to second nutrition assessment distributions of SGA and physical examination attributes reflect a shift as the overall SGA nutrition ratings improved. The overall rating is derived from these attributes in addition to body weight, body weight change, and BMI. It would be expected that those subjects with lower attribute ratings would also have lower overall SGA nutrition ratings.

The implementation of a nutrition intervention shows that the lower the nutrition status rating, the more likely that there was an intervention. All subjects in the severely malnourished category had a nutrition intervention. Likewise, the more well nourished a subject was, the less likely there was to be an intervention. The distribution of nutrition interventions changed from initial nutrition assessment to the second nutrition assessment. The presence of an intervention may have helped improve nutrition status in subjects, since it has been previously shown that the overall nutrition ratings did significantly improve from initial nutrition assessment to the second nutrition assessment. For the smaller number of subjects (28% initial assessment, 23% second assessment) who were in the "1" category for nutrition intervention, they were noted to be fairly stable nutritionally, no weight change, no appetite problems, and no current major medical issues. These subjects may not have required an intervention at the time; however, they would be a group to watch closely, as any change in status could quickly affect their nutrition status. In addition to the nutrition intervention, BMI and weight were the only other variables that were significantly different among the overall nutrition rating categories (3-point scale, Tables 5 and 6). This would be expected, as some subjects that are at the lowest weight and BMI may be underweight and therefore malnourished.

Additional variables, such as BUN, creatinine, hemoglobin, and hematocrit were not significantly different. This would be expected since the level of residual kidney function affects BUN and creatinine levels. Other multiple factors affect hemoglobin and hematocrit, such as bleeding, infection, and response to erythropoietin therapy. Transferrin, cholesterol, and triglyceride were not significantly different. Cholesterol and triglyceride may sometimes be monitored for trends in clinical practice as other factors to consider when evaluating nutrition status; however, there are other variables to consider such as the impact of lipid disorders and effect of lipid lowering medications.

Serum albumin was not significantly different among the nutrition ratings in either the initial or second nutrition assessments. This is a very significant finding since albumin is often quoted in the literature as a measure of visceral protein stores (35). There are also several articles that did not find albumin associated with SGA or nutrition status (21, 22). The concern with using albumin for evaluating nutrition status is that there are so many other factors that cause albumin levels to be inaccurate as an indicator of nutrition status, such as hydration status, inflammation, blood loss, liver disease, proteinuria, and type of laboratory method used (35, 37). The bromcresol green (BCG) method for albumin is preferred to be used for chronic renal failure patients, with a goal of 4.0 g/dl (35). The bromcresol purple (BCP) method is used by some laboratories, which may underestimate values by up to 19% (35). Clinically, the BCP method has proven to be less reliable than the BCG method (35). Ninety-five percent of the serum albumin concentrations in this study were measured by the BCG method and 5% by the BCP method. The KDOQI clinical practice guidelines for nutrition suggest that, if the BCP method must be used, then less clinical weight might be given to serum albumin concentrations and other markers of malnutrition in ESRD patients might be more heavily weighted (35). The KDOQI guidelines also note that the presence of acute or chronic inflammation limits the specificity of serum albumin as a nutritional marker (35). Also considering that albumin has an approximate half-life of 20 days, and, so by the time a level is drawn, it will reflect the subject's status nearly three weeks earlier (38). Pre-albumin has a much shorter half-life of 2-3 days but may not always be available (38). In this study, the initial nutrition assessment, subjects in the severely malnourished category had a mean albumin of 3.5 g/dl (normal $\geq$ 3.5 g/dl). In the second nutrition assessment, the only subject that was still classified as severely malnourished had an albumin of 3.9 g/dl.

Since there is not a singular laboratory measurement or test that absolutely predicts or identifies malnutrition or response to nutrition intervention, several different tests and measurements should be utilized in clinical dietetic practice. So, instead of being dependent on albumin, methods such as SGA and expanded physical assessment (as used in this study) should be used in hemodialysis patients to determine how the person physically looks and not just interpret nutrition status from one objective measure such as albumin.

References

1. U.S. Renal Data System, USRDS 2003 Annual Data Report: Atlas of End-Stage Renal Disease in the United States, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2003
2. U.S. Government Printing Office, Code of Federal Regulations, Title 42, volume 2, pp 137-158, http://www.gpoaccess.gov/index.html (date retrieved: November 14, 2003)
3. Collins AJ, Ma JZ, Umen A, Keshaviah P: Urea index and other predictors of hemodialysis patient survival. Am J Kidney Dis 23:272-282, 1994
4. Lowrie EG, Lew NL: Death risk in hemodialysis patients: The predictive value of commonly measured variables and an evaluation of death rate differences between facilities. Am J Kidney Dis 15:458-482, 1990
5. Lowrie EG, Laird NM, Parker TF, Sargent JA: Effect of the hemodialysis prescription on patient morbidity. N Engl J Med 305:1176-1181, 1981
6. Degoulet P, Legrain M, Reach I, Francoise A, Devries C, Rojas P, Jacobs C: Mortality risk factors in patients treated by chronic hemodialysis. Nephron 31:103-110, 1982
7. Churchill DN, Taylor W, Cook RJ, LaPlante P, Barre P, Cartier P, Fay WP, Goldstein MB, Jindal K, Mandin H, McKenzie JK, Muirhead N, Parfrey PS, Posen GA, Slaughter

D, Ulan RA, Werb R: Canadian hemodialysis morbidity study. Am J Kidney Dis 19:214-234, 1992

8. Herselman M, Rafique Moosa M, Kotze TJ, Kritzinger M, Wuister S, Mostert D: Protein-energy malnutrition as a risk factor for increased morbidity in long-term hemodialysis patients. J Renal Nutr 10:7-15, 2000
9. Acchiardo SR, Moore LW, Latour PA: Malnutrition as the main factor in morbidity and mortality of hemodialysis patients. Kidney Int 24:199-203, 1983 (suppl 16)
10. Ikizler TA, Flakoll PJ, Parker RA, Hakim RM: Amino acid and albumin losses during hemodialysis. Kidney Int 46:830-837, 1994
11. Rock CL, Bidigare DeRoeck M, Gorenflo DW, Jahnke MG, Swartz RD, Messana JM: Current prevalence of vitamin B_6 deficiency in hemodialysis and peritoneal dialysis patients. J Renal Nutr 7:10-16, 1997
12. Slomowitz LA, Monteon FJ, Grosvenor M, Laidlaw SA, Kopple JD: Effect of energy intake on nutritional status in maintenance hemodialysis patients. Kidney Int 35:704-711, 1989
13. Sehgal AR, Leon J, Soinski JA: Barriers to adequate protein nutrition among hemodialysis patients. J Renal Nutr 8:179-187, 1998
14. Rocco MV, Poole D, Poindexter P, Jordan J, Burkart JM: Intake of vitamins and minerals in stable hemodialysis patients as determined by 9-day food records. J Renal Nutr 7:17-24, 1997
15. Kalantar-Zadeh K, Kopple JD, Deepak S, Block D, Block G: Food intake characteristics of hemodialysis patients as obtained by food frequency questionnaire. J Renal Nutr 12:17-31, 2002

16. Boaz M, Green M, Smetana S: A comparison of dietary intake estimates in a population with chronic renal failure. J Renal Nutr 7:134-143, 1997

17. Ohri-Vachaspati P, Sehgal AR: Correlates of poor appetite among hemodialysis patients. J Renal Nutr 9:182-185, 1999

18. Duggan A, Huffman FG: Validation of serum transthyretin (prealbumin) as a nutritional parameter in hemodialysis patients. J Renal Nutr 8:142-150, 1998

19. Jeejeebhoy KN, Detsky AS, Baker JP: Assessment of nutritional status. JPEN 14:193-196, 1990 (suppl)

20. Baker JP, Detsky AS, Wesson DE, Wolman SL, Stewart S, Whitewell J, Langer B, Jeejeebhoy KN: Nutrition assessment: A comparison of clinical judgment and objective measurements. N Engl J Med 306:969-972, 1982

21. Biesenbach G, Debska-Slizien A, Zazgornik J: Nutritional status in type 2 diabetic patients requiring haemodialysis. Nephrol Dial Transplant 14:655-658, 1999

22. Ek AC, Unosson M, Larsson J, Ganowiak W, Bjurulf P: Interrater variability and validity in subjective nutritional assessment of elderly patients. Scand J Caring Sci 10:163-168, 1996

23. Bilbery GL, Cohen TL: Indentification and treatment of protein calorie malnutrition in chronic hemodialysis patients. Dial Transplant 18:669-700, 1989

24. Stenvinkel P, Heimburger O, Paultre F, Diczfalusy U, Wang T, Berglund L, Jogestrand T: Strong association between malnutrition, inflammation, and atherosclerosis in chronic renal failure. Kidney Int 55:1899-1911, 1999

25. Kalantar-Zadeh K, Kleiner M, Dunne E, Ahern K, Nelson M, Koslowe R, Luft FC: Total iron-binding capacity-estimated transferrin correlates with the nutritional subjective global assessment in hemodialysis patients. Am J Kidney Dis 31:263-272, 1998

26. Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, Jeejeebhoy KN: What is subjective global assessment of nutritional status? JPEN 11:8-13, 1987

27. Cianciaruso B, Brunori G, Kopple JD, Traverso G, Panarello G, Enia G, Strippoli P, De Vecchi A, Querques M, Viglino G, Vonesh E, Maiorca R: Cross-sectional comparison of malnutrition in continuous ambulatory peritoneal dialysis and hemodialysis patients. Am J Kidney Dis 26:475-486, 1995

28. Hirsch S, Obaldia N, Petermann M, Rojo P, Barrientos C, Iturriaga H, Bunout D: Subjective global assessment of nutritional status: Further validation. Nutrition 7:35-38, 1991

29. Kalantar-Zadeh K, Kleiner M, Dunne E, Lee GH, Luft FC: A modified quantitative subjective global assessment of nutrition for dialysis patients. Nephrol Dial Transplant 14:1732-1738, 1999

30. Kelly MP, Kight MA, Castillo S: Trophic implications of altered body composition observed in or near nails of hemodialysis patients. Adv Renal Rep Therapy 5:241-251

31. Kelly MP, Kight MA, Rodriguez R, Castillo S: A diagnostically reasoned case study with particular emphasis on B6 and zinc imbalance directed by clinical history and nutrition physical examination findings. Nutrition in Clinical Practice 13:32-39, 1998

32. Enia G, Sicuso C, Alati G, Zoccali C: Subjective global assessment of nutrition in dialysis patients. Nephrol Dial Transplant 8:1094-1098, 1993

33. Dumler F, Kilates C, Wagner C, Butler R: Surveillance of nutritional status in chronic dialysis patients. J Renal Nutr 7:194-198, 1997

34. Laws RA, Tapsell LC, Kelly J: Nutritional status and its relationship to quality of life in a sample of chronic hemodialysis patients. J Renal Nutr 10:139-147, 2000

35. National Kidney Foundation Kidney Disease Outcomes Quality Initiative- Clinical practice guidelines for nutrition in chronic renal failure. Am J Kidney Dis 35:17-85, 2000 (suppl 2)

36. Chumba W, Guo SS, Vellas B: Assessment of protein-calorie nutrition, in Kopple JD, Massry SG (eds): Nutritional Management of Renal Disease. Baltimore, MD, Williams and Wilkins, 1997, pp 203-228

37. Fischbach F: A Manual of Laboratory and Diagnostic Tests. Philadelphia, PA, Lippincott, 1996, pp. 552-556

38. Alcock NW: Laboratory tests for assessing nutritional status, in Shils ME, Olson JA, Shike M, Ross AC (eds): Modern Nutrition in Disease. Baltimore, MD, Williams and Wilkins, 1999, pp 923-935

39. Gambro Laboratory Services, Ft. Lauderdale, FL

40. Satellite Laboratory Services, Redwood City, CA

41. Pathology Laboratory, Des Moines, IA

42. SPSS Inc., SPSS version 11.0, Chicago, IL, 2003

CHAPTER 4. GENERAL CONCLUSIONS

Some patients may be nutritionally or medically stable for many months or years, or their status may change very quickly. Subjective global assessment and nutrition-focused physical examination are tools that can be used to quickly evaluate a change in status.

It is important to assess body weight and also body weight change. Even if a patient is overweight but has lost a significant amount of weight, this may still contribute to the patient being at risk nutritionally. SGA and physical assessment are methods that, when incorporated with objective measures such as laboratory data, can provide an inexpensive, time efficient, and thorough assessment of nutritional status and should be recommended as a tool for more frequent assessment of nutritional status in dialysis patients.

Although using albumin as part of nutrition screening has been used in clinical dietetic practice, many factors may affect the albumin level, causing it to not accurately reflect nutrition status. If too much weight is given to the albumin level, nutrition problems may be inadvertently overlooked. SGA and nutrition-focused physical examination requires the clinician to evaluate the patient directly, in which case muscle and subcutaneous fat losses may be discovered, which would not have normally been noted, especially if the patient had a normal albumin concentration. For example, in this study, there was one subject in the severely malnourished category with an albumin concentration of 3.9 g/dl.

Alternately, the process may confirm that a patient is well nourished with adequate muscle and fat stores or may display even better than expected stores for age or with a concurrently low albumin concentration. SGA and nutrition-focused physical examination provides a short, reliable, reproducible, and inexpensive method to assess nutrition status in patients.

Current Clinical Nutritional Practice

SGA format is being recommended by Kidney Disease Outcomes Quality Initiative (KDOQI) to be performed as an assessment tool for all dialysis patients twice per year (35). Currently, the 7-point scale using the four categories of weight loss, anorexia, subcutaneous fat, and muscle mass is suggested (35). Although this is a recent recommendation, SGA has been recommended in literature (22, 24,25,26,27,28,29). However, a recent informal survey of approximately 30 renal dietitians from Iowa and Minnesota revealed that no one was currently using SGA format or physical assessment techniques (Iowa Council on Renal Nutrition Fall September 2001 Meeting, Ames, IA).

Barriers to Using SGA and Physical Examination

A common reason why practitioners are not currently using SGA or physical examination, is likely, "not enough time". Other barriers may include practitioners being uncomfortable "touching a patient". By allowing time for training to increase confidence in using SGA and physical assessment, these methods can be integrated into practice in a way that allows for time efficiency, which is the intention of the method. Many of the methods and forms dietitians are currently using for nutrition assessment can be expanded to include SGA and physical assessment, so that these methods do not have to be in addition to what the dietitian is already doing.

Improving nutrition assessment skills will lead to improved interventions and outcomes through earlier recognition of nutrition problems. If the nutrition assessment component currently being used in a practice setting is not sensitive enough to detect nutrition problems, then the probability of providing appropriate and intervention is greatly diminished.

This study shows that SGA with expanded physical assessment can provide a comprehensive and accurate nutrition assessment to identify subjects in need of a nutrition intervention. Recommendations for further study include evaluation of SGA and nutrition-focused physical examination in regard to improving nutritional quality of life outcomes for patients receiving hemodialysis.

APPENDIX A. INFORMED CONSENT FORM

ISU IRB #1
APPROVED DATE: February 10, 2003
EXPIRATION DATE: February 9, 2004

Kidney Care
1215 Pleasant, Suite 106
Des Moines, IA 50309
(515)241-5714
(515)241-5750 (fax)

Kidney Care East
700 E. University Ave.
Des Moines, IA 50316
(515) 263-5214
(515) 263-5462 (fax)

Craig A. Shadur, M.D.
Prem K.G. Chandran, M.D.
Michael T. Flood, D.O.
Robert H. Leisy, D.O.
Sanjiv Dahal, M.D.
Mark Belz, M.D.

Nephrology - Internal Medicine
Acute and Long Term Dialysis

INFORMED CONSENT FORM

Comparing the Effectiveness of Subjective Global Assessment (SGA) and Nutrition-Focused Physical Exam with Standard Nutritional Assessment Practices for Subjects on Hemodialysis.

You are being asked to participate in a research study. In order to decide whether or not you want to be a part of this research study, you should understand enough about its risks and benefits to make an informed judgment. This process is known as *informed consent*.

If you decide to participate in this study, you will need to read this informed consent form. This consent form gives detailed information about the research study that will be discussed with you. Once you understand the study, you will be asked to sign this form if you wish to participate. Your signature on the last page will indicate you understand all of the information that has been provided (written and verbal) and that you are volunteering to participate.

EXPLANATION OF STUDY

Nature and Purpose of Research Study: The purpose of the study is to compare traditional methods of nutritional assessment with an expanded method called Subjective Global Assessment and Nutrition-Focused Physical Exam. We hope that with the information gathered we are able to provide improved nutritional care for people on hemodialysis. Typical nutrition assessment of hemodialysis patients usually includes monitoring your weight, appetite, food intake, and laboratory results such as albumin (protein level). Although these methods may be effective, additional assessment that includes asking you about frequency of nausea, vomiting, diarrhea, constipation, your current activity level, and looking at your muscle and fat stores may provide additional nutrition information. The physical exam portion includes looking at muscle and fat stores in the arm, lower leg, shoulder/collar bone, and facial area. Eyes, nails, and skin are looked at to screen for abnormalities that may be related to your nutritional status. It is with this additional information, that a more in-depth and possibly more accurate nutritional assessment may be made. Your laboratory parameters such as albumin (protein level) are helpful, however, they may not always accurately reflect your true nutritional status. This study would include approximately 45 to 50 hemodialysis patients. If there is a nutritional problem found, you will be provided with dietary counseling regarding your food intake, nutrition supplements may be recommended, your nutrition status will be monitored (weekly) and any nutrition concerns will be communicated to your health care team (doctor, nurse, social worker). The nutrition care you would receive may include additional interventions not listed above, and would be individualized based on your current nutrition status and medical condition.

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Explanation of Procedures:
If you agree to participate in this study, your participation will last for six months. Two interviews will be conducted, one at the beginning of the study and one six months later. Each will last approximately 15-20 minutes. The interviews will be conducted while you are on hemodialysis.
During the study you may expect the following study procedures to be followed. You will be interviewed. This will take approximately 5-10 minutes. You may skip any question that you do not wish to answer or that makes you feel uncomfortable. Next a brief physical exam will be performed. This will also take 5-10 minutes. The physical exam involves looking at your face, hands, nails, collar bone, lower leg; your muscle and fat stores will be examined in your upper arm and lower leg. This information is combined with your laboratory data, and your weight information. Chart reviews of previous dietary notes and laboratory data prior to using the interviews and physical exam would be included in this study.

RISKS AND DISCOMFORTS There is very little risk or discomfort involved. The physical examination is limited to looking at hands, face, eyes, collar bone, lower leg; feeling with thumb and forefinger or with hand the upper arm (bicep/tricep), shoulder and calf muscle. The interviewer will discuss with you the steps of the physical exam prior to performing the exam.

PREGNANCY CLAUSE There are no risks involved for subjects who are pregnant or who may become pregnant.

POSSIBLE BENEFITS
You may have improved nutritional assessment with the evaluation of muscle and fat stores and general condition of skin, nails and eyes. You may have improved detection of nutritional problems or potential nutritional problems, so that any needed intervention may be provided earlier and possibly more accurately and effectively. You may benefit from improved nutritional assessment, which may help identify nutritional problems that impede your activity level.
If you decide to participate in this study there may be no direct benefit to you. It is hoped that the information gained in this study will benefit society by improving nutritional assessment skills of other dietitians.

ALTERNATIVE THERAPY You may choose to receive the standard nutritional assessment.

CONFIDENTIALITY Confidentiality of records will be maintained .
Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken
A numerical coding system will be used instead of subject names for interview data, chart notes and laboratory data. The prinicpal investigator (Beth Nichols), Dr. Mary Jane Oakland and an undergraduate assistant will have access to the data. The data will be stored in a locked file cabinet in the FSHN department at Iowa State University. Any electronic data will be stored on a disk (protected by password) also in a locked filing cabinet. The data will be retained for a period of five years before destruction. If the results are published, your identity will remain confidential.

Publication of data may result from this investigation for the purpose of advancing knowledge. Participants will not be identified personally in any reports from this study. Your records may be examined by other researchers in this study, by the sponsoring organization, or by the Food and Drug Administration (FDA). Every effort will be made to keep personal medical data confidential.

COMPENSATION DISCLAIMER

In the event of physical injury resulting from research procedures while enrolled in this research study, medical treatment for injuries or illness is available through Iowa Methodist/Iowa Lutheran and/or Blank Children's Hospital. No promise is made to provide free medical care or payment for any unfavorable results because of participation in this study. Payment for expenses of unfavorable results will be your own responsibility.

PEOPLE TO WHOM QUESTIONS CAN BE ADDRESSED

Additional information about your rights as a research subject is available from the Methodist/Lutheran and Blank Children's Hospital Institutional Review Board at 515-241-5790.

Any research related injuries should be reported to the principal investigator, Beth Nichols at 515-263-5656 or Dr. Mary Jane Oakland at 515-294-2536.

PAYMENT FOR PARTICIPATION

There is no payment to you for participation in this project.

ADDITIONAL COSTS

There will be no additional cost to you for participating in this research study.

EXPLANATION OF ABILITY TO WITHDRAW FROM STUDY

Your participation in this research study is voluntary. If you decide not to participate in this study, your care will not be jeopardized, and you will receive conventional treatment for your condition according to your attending physician's recommendations. You are free to withdraw this consent and to discontinue participation in the described activities, treatment and research at any time without prejudice. In addition, the investigator may withdraw you from the study if he feels it is in your best interest.

CONSENT TO PARTICIPATE

I understand that this study will be supervised by Beth Nichols RD, CSR, LD, (Ph: (515) 263-5656) and Dr. Mary Jane Oakland PhD, RD, LD (Ph: (515)-294-2536) and whomever he(she) may designate as his(her) assistants. I have read the explanation of this study and understand the Informed Consent. With the knowledge of the nature and purpose of the study, the treatment, the possible attendant risks and discomforts, the possible benefits and the possible alternative methods of treatment, I voluntarily agree to participate in the **Subjective Global Assessment and Nutrition-Focused Physical Exam** study.

I have read and discussed the explanation of this study. I have had enough time to discuss all of my questions and concerns. I will receive a copy of this Consent Form.

______________________________ ______________________
Subject Date

______________________________ ______________________
Investigator Date

APPENDIX B. SUBJECTIVE GLOBAL ASSESSMENT AND NUTRITIONAL PHYSICAL ASSESSMENT FORM

Name : ______________________________ Date: ____________

Lab Data:

Ca^{++} ________mg/dl Alb ________g/dl Dry Weight ________ kg

PO4 ________mg/dl K^{+} ________Meq/L 1 month ago ________ kg

Other ______________________________ 6 mo. ago ________ kg

% wt. change ________ kg

BMI ________

PATIENT COMMENTS: ______________________________

____

GI Symptoms: (note frequency: daily, 2-3 x/wk, <1x/wk, never)

NONE: ________ ANOREXIA: ________ ALTERED TASTE/SMELL: ________

N/V/D/C: ________ PAIN: ________ MOUTH SORES/DRY MOUTH: ________

Activity level: same as usual ______ better than usual ______ lower than usual ______

In what way? ______________________________

PHYSICAL EXAM:

SKIN: Face ________ Lower limbs ________ Lesions ________

EYES: Moisture ________ Sclera ________

Lesions ________ Tissue around eye ________

NAILS: Nail plate color ________ Texture ________

Nail bed color ________ Tissue around nail bed ________

FAT STORES: Under eye ______ Tricep ______ Bicep ______

SOMATIC WASTING:

Temporal ________ Interosseous ________ Clavicle ________ Prostheses ________

Lower Leg ________ Upper Arm ________

SGA & Physical Exam Rating : ______________________________

Assessment: ______________________________

____

____

____

Plan: ______________________________

____

____

____

______________________ RD CSR LD

RATINGS: 1-2 SEVERELY MALNOURISHED 3-5 MODERATE TO MILD MALNOURISHED 6-7 WELL NOURISHED

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