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CLINICAL STUDY

A Cohort Study of Subjective Global Assessment and Mortality in Taiwanese Hemodialysis Patients

Fwu-Lin Yang
Division of Surgical Critical Care Unit, Buddhist Tzu Chi General Hospital, and School of Medicine, Tzu Chi University, Hualien, Taiwan

Ru-Ping Lee
Department of Nursing, Tzu Chi University, Hualien, Taiwan

Chih-Hsien Wang
Division of Nephrology, Buddhist Tzu Chi General Hospital, Hualien, Taiwan

Te-Chao Fang and Bang-Gee Hsu
Division of Nephrology, Buddhist Tzu Chi General Hospital, and School of Medicine, Tzu Chi University, Hualien, Taiwan

Many patients with end-stage renal disease are malnourished, and cross-sectional studies have shown that markers of malnutrition may predict death. In this study, we investigated the possible association of Subjective Global Assessment and mortality in a small cohort of Taiwanese hemodialysis patients. Fifty hemodialysis patients at a hemodialysis center in eastern Taiwan were enrolled in June 2002. Height and weight were used to determine the body mass index. Bioelectrical impedance analysis of body fat mass was performed before and after a mid-week dialysis session. Biochemical indexes of the nutritional status included serum albumin, creatinine, transferrin, cholesterol, and the normalized protein catabolic rate. Mortality data during 42 months after enrollment were obtained. Twenty-six hemodialysis patients were classified as well-nourished and twenty-four as malnourished based on Subjective Global Assessment. Decreased body mass index ($p = 0.006$), increased body fat mass ($p = 0.019$ before hemodialysis; $p = 0.007$ after hemodialysis), decreased serum albumin ($p = 0.011$), and decreased serum creatinine ($p = 0.006$) were significantly higher in the malnourished group. Older age ($p = 0.042$), decreased serum albumin ($p = 0.028$), decreased serum transferrin ($p = 0.041$), and malnourishment ($p = 0.004$) were significantly higher in the mortality group. Multivariate forward stepwise linear regression analysis of mortality and nutrition profiles show that Subjective Global Assessment is the independent predictor of mortality ($R^2 = 0.20$). Malnourished hemodialysis patients had a higher mortality rate than well-nourished hemodialysis patients in Taiwan. Subjective Global Assessment of the nutritional status appears to be a simple tool for assessing the nutritional status of hemodialysis patients in long-term care. This assessment tool is also beneficial for hemodialysis patients who are at a greater risk of nutritional-associated mortality.

Keywords subjective global assessment, hemodialysis, mortality

Address correspondence to Bang-Gee Hsu, M.D., PhD., Division of Nephrology, Buddhist Tzu Chi General Hospital, 707, Section 3, Chung-Yang Road, Hualien, Taiwan; Tel.: +886 3 8561825; Fax: +886 3 8577161; E-mail: geelily@mail.edu.tcu.tw

INTRODUCTION

Malnutrition is common and associated with increased morbidity and mortality in hemodialysis patients.[1–3] Cardiovascular mortality is the leading cause of death in patients treated by dialysis, with mortality 10 to 30 times higher than in the general population.[4] Atherosclerosis is the predominant cardiovascular disease, which accounts for more than 50% of deaths of dialysis patients.[5] This may be due to malnutrition, inflammation, and atherosclerosis (MIA). The MIA hypothesis proposes an association between malnutrition and atherosclerosis.[6,7] Thus, malnutrition is a uremic risk factor for cardiovascular diseases.[8]

Subjective Global Assessment (SGA) is a reproducible clinical assessment tool that correlates well with other

measures of nutritional status and predicts hospital-related complications.[9] SGA can aid in the recognition of malnutrition by allowing for subjective assessment of a patient's nutritional status based upon features of medical history and physical examination.[10] The SGA classification technique of the nutritional status has been used as a diagnostic tool and prognostic instrument for hemodialysis patients, surgery patients, and liver transplantation patients.[11–13] The aim of this study is to investigate the possible association of nutrition and mortality in Taiwanese hemodialysis patients.

MATERIALS AND METHODS

Patients

Fifty hemodialysis patients, comprising 21 males and 29 females aged from 24 to 84 years, were studied in June 2002 in a medical center in Hualien, which is located in eastern Taiwan. The Protection of Human Subjects Institutional Review Board at Tzu-Chi University and Hospital approved this study. As clinically indicated, hemodialysis was performed three times a week by a disposable dialyzer with standard bicarbonate dialysate. Anthropometric measurements included height and weight measurements. Body mass index (BMI) was determined according to kilogram per meter squared. Kt/V, the urea reduction ratio (URR), the normalized protein catabolic rate (nPCR), and the time-averaged concentration (TAC) were measured pre-dialysis, and immediate post-dialysis blood urea nitrogen (BUN) levels were measured using a formal single-compartment dialysis urea kinetic model.

Biochemical Investigations

Fasting serum samples taken before dialysis from each subject were immediately centrifuged for biochemical study. Blood samples were immediately centrifuged at 3,000 rpm for 10 minutes. Serum aminotransferases (AST and ALT), albumin, transferrin, BUN, creatinine, fasting glucose, total cholesterol, and triglycerides were measured with an autoanalyzer (Hitachi 747, Tokyo, Japan) and calculated according to the manufacturer's equations.

SGA

SGA includes six subjective assessments, three of which are based on the patient's history of weight loss, incidence of anorexia, and incidence of vomiting. The rest are based on the physician's grading of muscle wasting, the presence of edema, and the loss of subcutaneous fat. These variables are graded as: 1 = none, 2 = mild, 3 = moderate, and 4 = severe. The sum of the respective scores of the six subjective assessments is considered to be an ordinal variable in statistical analysis. In this study, SGA was performed by a trained investigator, and the SGA examiner was not aware of the laboratory test results at the time of the assessment. Patients were divided into groups according to the SGA score. Those with an ordinal SGA score between six and eight were placed in the well-nourished group, and those with an ordinal SGA sore equal to or more than nine were placed in the malnourished group.[14]

Bioimpedance Analysis

Impedance measurements were performed at the bedside according to the standard, tetrapolar, whole body (hand-foot) technique, using a single frequency (50-kHz) analyzer (Biodynamic-450, Biodynamics Corporation, Seattle, Washington, USA). Measurements were carried out by the same operator 20 minutes before and after dialysis; fat mass was collected and analyzed by specific formulae offered by the manufacturer.

Mortality Follow-Up

Mortality data during the 42 months after enrollment into the study were obtained.

Statistical Analysis

Data are expressed as case number and analysis by chi-square test between malnourished and well-nourished patients. Other data are expressed as mean ± standard deviation (SD) and compared using the Student *t*-test. After this, variables significantly associated with mortality in hemodialysis were tested for independency in multivariate forward stepwise analysis. Data were analyzed using SPSS for Windows (version 10.0; SPSS Inc., Chicago, Illinois, USA). A p value of less than 0.05 was considered statistically significant.

RESULTS

The basic clinical characteristics of the hemodialysis patients are presented in Table 1. Twenty-one patients were male and 29 were female. Twenty-four patients were aged below 65 years. The causes of

Table 1
Baseline clinical characteristics of hemodialysis patients in the study

Characteristics	Percentage
Sex	
Male	42%
Female	58%
Age	
<65 years	48%
≥65 years	52%
Cause of ESRD	
Diabetes	34%
Hypertension	32%
Glomerulonephritis	28%
Others	6%
Duration of hemodialysis	
<5 years	28%
≥5 years and <10 years	58%
≥10 years	14%

uremia varied: 17 patients suffered from uremia due to diabetes mellitus, 16 due to hypertension, and 14 due to chronic glomerulonephritis. Duration of hemodialysis of less than five years was 28%, whereas that of over 10 years was 7%.

Patients were divided into a well-nourished group and a malnourished group based on SGA, and the characteristics of each group are presented in Table 2. Twenty-six patients (52%) were well-nourished, whereas 24 patients (48%) were malnourished. The pre-dialysis body fat mass (p = 0.019) and post-dialysis body fat mass (p = 0.007) were higher in the malnourished group. BMI (p = 0.006), serum albumin (p = 0.011), and serum creatinine (p = 0.006) were higher in the well-nourished group. There were no statistically significant differences in age, height, weight, gender distribution, causes of hemodialysis, duration of hemodialysis, serum transferrin level, mean AST level, mean ALT level, total cholesterol, triglyceride, fasting glucose, URR, Kt/V urea, nPCR, and TAC urea between the well-nourished group and the malnourished group.

The clinical mortality profiles of hemodialysis are presented in Table 3. Eleven hemodialysis patients died during the ensuing 42 months following the SGA study. Older age (p = 0.042), decreased serum albumin (p = 0.028), decreased serum transferrin (p = 0.041), and malnourishment (p = 0.004) were significantly higher in the mortality group. There were no statistically significant differences in height, weight, gender distribution, BMI, body fat mass, mean AST level, mean ALT level, total cholesterol, triglyceride, fasting glucose, creatinine, URR, Kt/V urea, nPCR, and TAC urea between the surviving group and the deceased group. Multivariate forward stepwise linear regression analysis of mortality and nutrition profiles showed that SGA was the independent predictor of mortality (R^2 = 0.20), and the results are presented in Table 4.

Table 2
Comparison of clinical profiles and nutritional status between well-nourished and malnourished patients

Characteristic	Well-nourished (n = 26)	Malnourished (n = 24)	p value
Age (year)	58.88 ± 12.90	60.63 ± 11.01	NS
Sex, male/female†	11/15	10/14	NS
Causes of hemodialysis†			
Diabetes mellitus	9	8	NS
Hypertension	8	7	NS
Glomerulonephritis	7	7	NS
Others	2	1	NS
Duration of hemodialysis†			
< 5 years	7	7	NS
≥ 5 years and < 10 years	15	14	NS
≥ 10 years	4	3	NS
Height (cm)	157.73 ± 8.13	157.79 ± 9.07	NS
Weight (kg)	53.63 ± 13.75	57.02 ± 11.13	NS
BMI (body mass index) (kg/m^2)	24.17 ± 4.09	21.13 ± 3.35	0.006*
Body fat mass, pre-dialysis (%)	22.62 ± 7.88	28.23 ± 8.41	0.019*
Body fat mass, post-dialysis (%)	30.70 ± 8.03	37.55 ± 9.10	0.007*
Albumin (g/dL)	3.79 ± 0.23	3.58 ± 0.32	0.011*
Transferrin (mg/dL)	175.2 ± 18.47	170.7 ± 26.22	NS
AST (U/L)	15.92 ± 8.53	18.67 ± 10.60	NS
ALT (U/L)	13.32 ± 5.16	18.08 ± 16.90	NS
Total cholesterol (mg/dL)	152.69 ± 28.88	161.96 ± 55.99	NS
Triglyceride (mg/dL)	194.46 ± 105.67	145.79 ± 73.35	NS
Glucose AC (mg/dL)	145.73 ± 58.83	163.96 ± 110.84	NS
Creatinine (mg/dL)	10.23 ± 2.55	8.26 ± 2.32	0.006*
URR	0.73 ± 0.07	0.75 ± 0.07	NS
Kt/Vurea	1.34 ± 0.25	1.43 ± 0.25	NS
nPCR (g/kg/day)	0.96 ± 0.17	1.02 ± 0.35	NS
TACurea (mg/dL)	38.81 ± 8.352	38.85 ± 14.96	NS

Data are expressed as means ± SD.

*p < 0.05, malnourished versus well-nourished patients by the student t test.

†Data are expressed as case number and analysis by Chi-square test.

Abbreviations: URR = urea reduction ratio, Kt/V = fractional clearance index for urea, nPCR = normalized protein catabolic rate, TACurea = time-averaged concentration of urea.

Table 3
Clinical mortality profiles of hemodialysis patients

Characteristic	Dead (n = 11)	Alive (n = 39)	*p* value
Sex†			
Male	4	17	NS
Female	7	22	
SGA†			
Malnourished	8	16	0.004*
Well-nourished	3	23	
Age (year)	68.45 ± 6.55	62.18 ± 13.93	0.042*
Height (cm)	157.18 ± 9.20	157.92 ± 8.42	NS
Weight (kg)	52.08 ± 11.53	56.15 ± 12.82	NS
BMI (body mass index) (kg/m^2)	21.76 ± 2.91	22.97 ± 4.27	NS
Body fat mass, pre-dialysis (%)	25.51 ± 10.65	25.26 ± 8.01	NS
Body fat mass, post-dialysis (%)	34.53 ± 9.82	33.84 ± 7.08	NS
Albumin (g/dL)	3.58 ± 0.98	3.72 ± 0.33	0.028*
Transferrin (mg/dL)	185.2 ± 18.65	169.6 ± 22.38	0.04*
AST (U/L)	16.36 ± 7.46	17.49 ± 10.17	NS
ALT (U/L)	13.09 ± 5.07	16.29 ± 13.75	NS
Total cholesterol (mg/dL)	147.7 ± 30.34	159.8 ± 46.89	NS
Triglyceride (mg/dL)	153.4 ± 81.51	176.1 ± 97.55	NS
Glucose AC (mg/dL)	147.18 ± 58.36	156.54 ± 94.37	NS
Creatinine (mg/dL)	8.43 ± 2.57	9.53 ± 2.60	NS
URR	0.73 ± 0.09	0.74 ± 0.07	NS
Kt/Vurea	1.38 ± 0.29	1.38 ± 0.25	NS
nPCR (g/kg/day)	0.95 ± 0.38	1.00 ± 0.23	NS
TACurea (mg/dL)	37.55 ± 18.19	39.19 ± 9.68	NS

Data are expressed as means ± SD.

*$p < 0.05$, dead versus alive patients by the Student t test.

†Data are expressed as case number and analysis by chi-square test.

Table 4
Multivariate stepwise linear regression analysis of mortality

Item	β	R^2	R^2 change	*p* value
SGA	0.343	0.200	0.200	0.012

Dependent variable: mortality; independent variables: age, serum albumin, serum transferrin, and SGA.

DISCUSSION

This study shows that, using SGA scores, malnourished hemodialysis patients have a higher mortality rate than well-nourished hemodialysis patients in Taiwan. SGA is a significant predictor of mortality for hemodialysis patients.

According to the National Kidney Foundation (NKF) Kidney Disease and Dialysis Outcome Quality Initiative (K/DOQI) nutrition in chronic renal failure guidelines, SGA is recommended as a routine measurement. This is because it is correlated with mortality rates, and because it gives a comprehensive overview of nutritional intake and body composition, including a rough assessment of both muscle mass and fat mass.[15] SGA is also an easy-to-use nutrition assessment tool that allows quick identification of malnutrition in hemodialysis patients.[16]

Inflammation and malnutrition are closely related to each other in dialysis patients.[6] Increased C reactive protein (CRP) is a significant risk factor for cardiovascular events and mortality in the end-stage renal disease (ESRD) population.[17] Hemodialysis patients with a high CRP level tend to be at a higher risk of mortality only if they are malnourished.[18] The simultaneous combination of malnutrition and inflammation has been referred to as the MIA syndrome.[6,7] The MIA syndrome appears to play a central role in poor clinical outcome, including the high rates of mortality and hospitalization, and in the diminished quality of life seen in hemodialysis patients. Moreover, MIA syndrome is also believed to be the underlying condition that leads to "reverse epidemiology" of cardiovascular risks in these patients, where a low, but not a high, BMI or serum cholesterol is associated with poor dialysis outcome.[19] Malnourished hemodialysis patients may influence the nutritional status either by reduced nutritional intake or by increased catabolism, resulting in depleted energy stores and a loss of somatic proteins. Our current study indicates older age, decreased serum albumin, decreased serum transferring, and higher SGA were significantly higher in the mortality group. These data also indicate that malnourished patients had higher cardiovascular mortality (7/8, data not shown) than the well-nourished ones (1/3, data not shown), and agree with previous studies that suggest that SGA is the most significant predictor of mortality in hemodialysis patients.[6,19,20]

There are some limitations to our study. First, the number of cases was small. Second, we did not check serum CRP or other inflammatory markers in this study, and could not find a relationship between mortality and MIA in hemodialysis patients. Third, we did not classify the nutritional status by other nutritional markers or by a multiple nutritional markers scoring system. Thus, it would appear that a number of large clinical randomized trials are needed to investigate whether malnourished hemodialysis patients have a higher mortality rate than well-nourished hemodialysis patients according to SGA scores containing inflammatory markers and cardiovascular events. Furthermore, whether the use of a scoring

system that contains multiple nutritional markers can provide a more precise classification of the nutritional status of hemodialysis patients compared with only using SGA scores needs further study.

In conclusion, SGA of the nutritional status appears to be simple to use and correlates strongly with other parameters of nutrition in hemodialysis patients. This assessment tool is also beneficial for hemodialysis patients who are at a greater risk of nutritional-associated mortality.

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