CORRELATION BETWEEN MODIFIED SUBJECTIVE GLOBAL ASSESSMENT WITH ANTHROPOMETRIC MEASUREMENTS AND LABORATOARY PARAMETERES

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Abstract- Although protein-calorie malnutrition is common among the hemodialysis patients and is associated with increased rates of morbidity and mortality, assessment of nutritional status of these patients is frequently ignored in many dialysis centers. Malnutrition can be estimated using a semiquantitative scale, subjective global assessment (SGA) but subjective nature of this scale restricts its reliability. In this study, we evaluated the malnutrition status in 71 hemodialysis patients by a recently developed, fully quantitative scoring system, dialysis malnutrition score (DMS) instead of conventional SGA and compared the results with laboratory and anthropometric measurements of malnutrition. Consequently, this revealed that DMS significantly correlated with the anthropometric measurements and an important laboratory parameter, serum transferrin level. The conventional SGA had only significant correlation with anthropometric measurements. These results confirmed the role of SGA as a reliable method in assessment of malnutrition, but it must be performed by a physician or trained nurse and is time consuming. Regarding these limitations, we suggest DMS as an alternative method for SGA in assessment of nutritional status of hemodialysis patients.

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Key words: anthropometric measurements; dialysis; malnutrition score; subjective global assessment (SGA); transferrin

INRTODUCTION

Protein calorie malnutrition is common in hemodialysis patients and is linked to increased morbidity and mortality (1-4). Nutritional status is frequently ignored in many dialysis centers while simple methods of nutritional assessment could have a favorable impact on patient management (5-9).

Several indices of malnutrition are available including the well known anthropometric measurements such as skin fold thickness, mid arm circumference (MAC) and mid arm muscle circumference (MAMC). However, the sensitivity of these methods in detecting early malnutrition, their practicability and their applicability to hemodialysis patients have not been convincing. More elaborate methods, such as dual energy X–ray absorptiometry (DEXA), bioelectrical impedance, near infrared interactance, total body nitrogen determinations and total body potassium estimates, may give reliable results, however, the techniques are costly and their use is confined to a few major research centers (10).

The subjective global assessment (SGA) was designed to circumvent many of these problems (1). SGA was initially developed to determine the nutritional status of patients undergoing gastrointestinal surgery (2) but it has also been applied to nutritionally deprived patients in other clinical settings, including hemodialysis. SGA is a clinically useful measure of protein–energy nutritional status in maintenance dialysis patients, but its semi-quantitative scale consisting of only three

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discrete severity levels, restricts its reliability. Using components of conventional SGA, a fully quantitative scoring system consisting of 7 components with total score ranging between 7 (normal) and 35 (severely malnourished), has been recently developed (1). While there are not definite descriptions for the majority of components of SGA and total result of SGA is mostly examiner-dependent, the proposed method is fully quantitative, performed in a few minutes, is free of cost, and definitely determines the nutritional status of hemodialysis patients. It seems that this method is superior to conventional SGA. One of the advantages of proposed method is that it takes into consideration hemodialysis duration; Kalantar-Zadeh *et al.* have shown the duration of hemodialysis is a potent predictor of the nutritional status of uremic patients (1,4).

MATERIALS AND METHODS

Patients

From over 130 patients currently served by Imam Khomeini Hospital affiliated dialysis program, we selected 71 hemodialysis patients who had never changed their modality of treatment (changed to peritoneal dialysis or transplantation), had not required hospitalization in the month prior to the study, had no signs of infection or disease activity (collagen vascular disease) and who agreed to participate.

Patients ranged in age from 17 to 81 years. All of the patients entered to this study had been hemodialyzed for 6 months to 12 years.

Conventional SGA

The assessment is based on the patient's history and physical examination. The history consists of five criteria and focuses on weight loss in the preceding 6 months, gastrointestinal symptoms such as anorexia, nausea, vomiting, diarrhea, dietary food intake, functional capacity and co-morbidities. The physical examination includes two items that focus on loss of subcutaneous fat and muscle wasting. The data are weighted and the patients are then classified in terms of three major SGA, A or 1= well nourished, B or 2= moderate malnutrition, C or 3= severe malnutrition.

Modified SGA

Dialysis malnutrition score consists of seven features: weight change, dietary intake, GI symptoms, functional capacity, co-morbidity, subcutaneous fat and signs of muscle wasting was recently developed, (Table 1). Each component has a score from 1 (normal) to 5 (very severe). Thus, the malnutrition score (sum of all seven components) is a number between 7 (normal) and 35 (severely malnourished). Therefore, a lower score denotes tendency towards a normal nutritional status. A higher score however is considered to be an indicator of the presence of malnutrition elements, i.e. the higher the nutritional score, the stronger the tendency towards protein calorie malnutrition. Table 1 shows the scoring sheet. The co-morbidity component of the SGA criteria was modified by incorporating the time on dialysis and advanced age; both these features have a bearing on nutrition. Physical examination is common in both SGA and DMS and is composed of two sections; subcutaneous fat and muscle wasting (Table 2) (7).

After completion of physical examinations, patients were placed in one of three groups: well nourished, mild to moderate malnutrition and severe malnutrition. These three groups are defined in SGA as A, B, and C and in DMS as 1, 3, and 5, respectively. Total nutritional scoring for each patient was assessed within 5 -15 min. Nutritional assessment by means of the modified quantitative SGA was performed on all 71 dialysis patients.

Anthropometric measurement

Body dry weight and skin–fold measurements were performed after termination of the dialysis session. Biceps skin–fold (BSF) and triceps skin–fold (TSF) were measured with skin–fold caliper. MAMC was derived according to the following formula:
MAMC = MAC – (3.1415 TSF). BMI was calculated as the ratio between end dialysis body weight in kilogram and the square of height in meter.

Laboratory evaluation

The following laboratory parameters were measured on all patients after the dialysis session: serum albumin, pre albumin, total protein, cholesterol, TIBC to estimate transferrin, iron, ferritin, creatinine and blood urea nitrogen. For statistical analysis we used Pearson's correlation and the Spearman rank correlation coefficient to assess the strength of association between variables.

Table 1. Malnutrition score adapted from the SGA

(A) patients related medical history
1**) weight change (overall change in past 6 months)**
1: no weight change or weight gain
2: minor weight loss < 5%
3: weight loss 5-10%
4: weight loss 10-15%
5: wight loss > 15%
2) dietary intake
1: no change
2: suboptimal solid diet
3: full liquid diet or moderate overall decrease
4: hypo-caloric liquid
5: starvation
3) Gastrointestinal symptoms
1: no symptoms
2: nausea
3: vomiting or moderate GI symptoms
4: diarrhea
5: severe anorexia
4) Functional capacity
1: none (improved)
2: difficulty with ambulation
3: difficulty with normal activity
4: light activity
5: bed ridden with no or little activity
5) Co-morbidity
1: MDH< 12 months and healthy otherwise
2: MDH 1-2 years or mild comorbidity
3: MDH 2-4, Age > 75 y or moderate comorbidity
4: MDH> 4 y or severe comorbidity
5: very severe multiple comorbidity
(B) Physical exam
1) decreased fat stores or loss of subcutaneous fat
1: none (no change)
3: moderate
5: severe
2) Signs of muscle wasting
1: none (no change)
3: moderate
5: severe

Abbreviation: SGA, subjective global assessment; MDH, maximum duration of hemodialysis.
*Five scale parameters are employed and the values are summed. A value of 7 is normal, while 35 is the most severe malnutrition.

RESULTS

Table 3 shows patients data. In average, the malnutrition scores between male and female groups were not significantly different. According to SGA, the majority of patients were located in the stage 2 of malnutrition, without significant differences between males and female.

The average malnutrition score was 15.41 ± 3.99. The malnutrition scores between male (14.73 ± 3.47) and female (16.29 ± 4.48) groups were not significantly different ($P = 0.10$).

Table 4 shows Pearson correlation coefficients (r) between the patients' quantitative nutrition scores and nutritionally relevant parameters. Pearson correlation coefficients (r) between the malnutrition score and other parameters were highly significant ($P < 0.01$) for weight (r = -0.381), BMI (r = -0.296), TSF (r = 0.449), BSF (r = -0.430), MAC (r = -0.495), MAMC (r = -0.352) and standard body weight (r = -0.330). The malnutrition score also significantly correlated ($P < 0.05$) with BMI (r = -0.296) and transferrin (r = -0.245) (Figures 1 to 5). However, no significant correlation was found between DMS and sex, age, years on dialysis, height, usual body weight, albumin, prealbumin, cholesterol, creatinine and hematocrit.

The conventional SGA had only significant correlation with anthropometric measurements (weight, BMI, TSF, BSF, MAC, MAMC and standard body weight) and not with laboratory parameters.

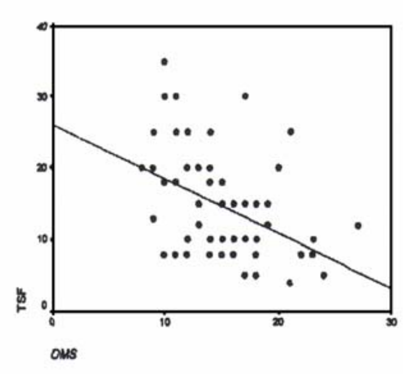

Fig. 1. Correlation between the dialysis malnutrition score (DMS) and triceps skin–fold (TSF) (r = -0.449 P= 0.000).

Table 2. Physical examination consists of subcutaneous fat and muscle wasting

Areas of Exam:	Tips	Severe Malnutrition	Mild – Moderate Malnutrition	Well Nourished
Subcutaneous Fat				
Below the eye	Look at patient straight on	Hollow look, depressions, dark circles, loose skin	Slightly dark circles, somewhat hollow look	Slightly bulged fat pads. Fluid may mask loss
Triceps / Biceps	Arm bent, do not include muscle in pinch, roll skin between fingers	Very little space between folds, fingers touch	Fingers almost touch, some depth to pinch	Ample fat tissue obvious between folder of skin
Muscle Wasting				
Temple	Observe straight on, have pt turn head side to side	Hollowing, scooping, depression	Slight depression	Can see/feel well defined muscle
Clavicle	Look for prominent bone	Protruding, prominent bone	Some protrusion	Not visible in male, visible but not prominent in female
Shoulder	Arms at side, look at shape	Shoulder to arm joint looks square	Acromion process may protrude slightly	Rounded, curves at junctions arm/ shoulder/ neck
Scapula	Have patient push hands against solid object	Prominent, visible bones, depressions below ribs/ scapula or shoulder/ spine	Mild depression or bone may show slightly	Lines of bones not prominent, no significant depressions
Interosseous Muscle	pads of thumb/forefinger touching	Depressed area between thumb forefinger	Slightly depressed or flat	Muscle bulges, could be flat in well nourished
Knee, Note: Lower body is less sensitive to change	Have patient sit with leg propped up, bent a knee	Bones prominent, little sign of musculature around knee cap	Knee cap less prominent more rounded	Muscle protrudes, bones not prominent
Quadriceps	Not as sensitive as upper body	Depression on inner thigh, obviously thin	Mild depression on inner thigh	Well rounded developed
Calf	Observe side and front view	Thin, minimal or no muscle definition	Not well developed	Well developed bulb of muscle
Edema, Ascites (HD only)				
R/O other causes of edema, patient at dry weight	View sacrum in activity restricted patient, ankle in mobile patient	Significant swelling	Mild to Moderate swelling	No sign of fluid accumulation

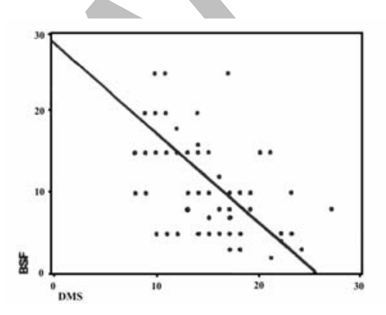

Fig. 2. Correlation between the dialysis malnutrition score (DMS) and biceps skin-fold (BSF) (r = -0.430, P = 0.000).

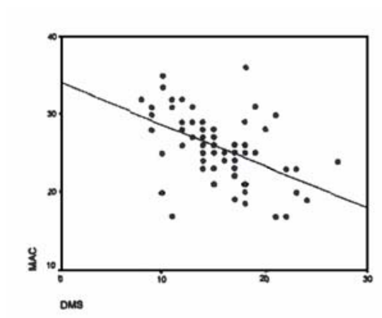

Fig. 3. Correlation between the dialysis malnutrition score (DMS) and midarm circumference (MAC) (r = -0.495, P = 0.000).

Table 3. Summary of data*

Parameter	All Patients (n= 71)	Male (n= 40)	Female (n=31)	*P* Value
DMS	15.41 ± 3.99	14.73 ± 3.47	16.29 ± 4.48	0.10
SGA	1.92 ± 0.50	1.90 ± 0.44	1.94 ± 0.57	0.39
Age (year)	51.66 ±18.38	47.58 ± 19.74	56.94 ± 15.19	0.032*
Weight (kg)	62.35 ± 13.38	65.79 ± 13.84	58.00 ± 11.58	0.015
Height (m)	1.61 ± 0.12	1.67 ± 0.10	1.53 ± 0.09	0.00*
BMI (kg/m^2)	23.88 ± 4.09	23.34 ± 4.00	24.56 ± 4.17	0.21
TSF (mm)	14.38 ± 6.77	12.38 ± 4.7	16.97 ± 8.11	0.004*
BSF (mm)	9.97 ± 5.69	8.23 ± 4.02	12.23 ± 6.72	0.003*
MAC (cm)	25.82 ± 4.31	26.19 ± 4.05	25.34 ± 4.64	0.41
MAMC (cm)	21.55 ±3.34	22.55 ± 3.43	20.25 ± 2.76	0.003*
UBW (%)	99.46 ± 9.31	100.55 ± 10.44	98.04 ± 7.55	0.26
SBW (%)	90.96 ± 15.39	91.81 ± 15.92	89.86 ± 15.79	0.60
Year on dialysis	3.91 ± 3.51	4.12 ± 3.93	3.64 ± 2.93	0.57
Albumin (g/dl)	3.86 ± 0.50	3.89 ± 0.55	3.82 ± 0.44	0.55
Total Protein (g/dl)	7.04 ± 0.64	7.01 ± 0.66	7.08 ± 0.62	0.62
Prealbumin (mg/dl)	28.51 ± 3.62	28.66 ± 3.48	28.31 ± 2.31	0.65
TIBC (µg/dl)	250.03 ± 60	251.11 ± 72.61	248.70 ± 40.56	0.72
Transferrin (mg/dl)	198.75 ±49.20	205.66 ± 56.72	190.24 ± 44.59	0.2
Cholesterol (mg/dl)	155.61 ± 38.84	144.00 ± 29.27	170.23 ± 44.59	0.004*
Creatinine (mg/dl)	8.33 ± 4.20	8.95 ± 4.99	7.51 ± 2.75	0.15
Hematocrit (%)	27.52 ± 6.05	28.29 ± 6.78	26.52 ± 4.88	0.22

Abbreviations: SGA, subjective global assessment; BMI, body mass index; TSF, triceps skin fold; BSF, biceps skin fold; MAC, mid arm circumference; MAMC, mid arm muscle circumference; UBW, usual body weight; SBW, standard body weight; TIBC, total iron binding capacity.
* Data are presented as mean±SD.
† Statistically significant.

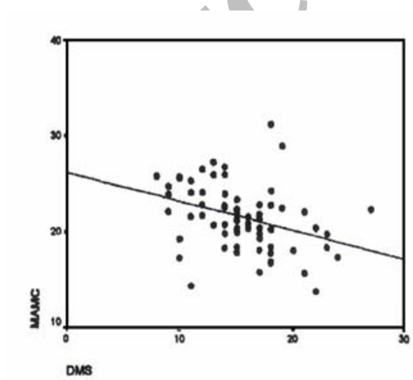

Fig. 4. Correlation between the dialysis malnutrition score (DMS) and midarm muscle circumference (MAMC) (r = -0.352, *P*= 0.003).

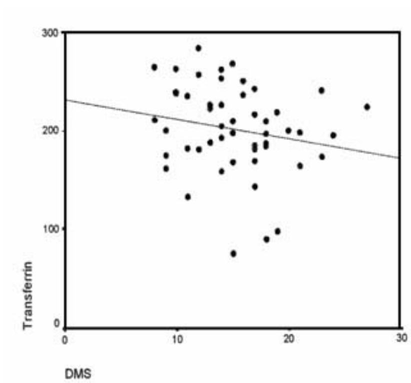

Fig. 5. Correlation between the dialysis malnutrition score (DMS) and Transferrin (r = -0.245, *P* = 0.04).

Table 4. Correlation between patients quantitative nutrition scores and nutritionally relevant parameters*

	Malnutrition Score (r)	*P* value	Conventional SGA (r)	*P* value
Sex	-0.196	0.102	-0.03	0.399
Age	-0.194	0.105	-0.025	0.837
Years on dialysis	-0.095	0.431	-0.139	0.246
Weight	-0.381†	0.001†	-0.458†	0.000†
Height	-0.216	0.071	0.196	0.102
BMI	-0.296†	0.012†	-0.417†	0.000†
TSF	-0449†	0.000†	-0.518†	0.000†
BSF	-0.430†	0.000†	-0.493†	0.000†
MAC	-0.495†	0.000†	-0.607†	0.000†
MAMC	-0.352†	0.003†	-0.454†	0.000†
UBW	-0.184	0.124	-0122	0.309
SBW	-0.330†	0.005	-0.406†	0.000†
Albumin	-0.205	0.088	-0.172	0.155
Total protein	-0.147	0.224	-0.154	0.264
Prealbumin	-0.154	0.244	-0.176	0.183
TIBC	-0.164	0.184	-0.040	0.750
Transferrin	-0.245†	0. 046†	-0.151	0.223
Cholesterol	-0.079	0.516	-0.168	0.175
Creatinine	-0.189	0.115	-0.117	0.331
Hematocrit	-0.061	0.614	-0.176	0.143

Abbreviations: SGA, subjective global assessment; BMI, body mass index; TSF, triceps skin fold; BSF, biceps skin fold; MAC, mid arm circumference; MAMC, mid arm muscle circumference; UBW, usual body weight; SBW, standard body weight; TIBC, total iron binding capacity.

* Left column shows Pearson correlation coefficients (r) between the malnutrition score (DMS), and other parameters. Right column shows Pearson correlation coefficients between the conventional SGA and other parameters.

† Significant at $P < 0.05$.

DISCUSSION

In patients on maintenance hemodialysis (HD), malnutrition is frequent and affects on quality of life and is associated with increased risk of mortality and morbidity (1-4).

Causes of malnutrition in HD patients are numerous (7,8). Ideal protocol to diagnose early malnutrition has not yet been created. So, nutritional status in maintenance dialysis patients should be assessed with combinations of valid complementary measures rather than any single measure alone. Nevertheless, the nutritional status of dialysis patients is frequently ignored.

Most indicators, especially biochemical ones such as serum albumin or transferrin are useful in identifying high risk patients but often are abnormal late in the course of a deteriorating nutritional state. Moreover they can be confounded by concomitant liver disease, iron deficiency anemia and chronic inflammation (2).

Several methods of nutritional state evaluation are available ranging from anthropometric measurements to more elaborate techniques such as DEXA and determination of laboratory parameters such as albumin, prealbumin, cholesterol and transferrin. However the reliability of these methods in detecting protein-calorie malnutrition and their practicability has not been proven. Moreover, more elaborate methods are costly and time–consuming, which restricts their use to a few research centers. Detsky *et al.* further defined special methodology, named SGA which was designed to circumvent many of these problems. It is easy to use and consists of only three discrete severity levels but closely correlated with more subjective measures (1,5). Unfortunately final assessment of each SGA criterion is solely depends on the subjective impression of the evaluator. Although it is easy to use, its semi quantitative feature decreases reliability and precision of the test. Overlap of nutritional scores is considerable between normal and abnormal SGA groups. Jones's *et al.*

suggested that SGA misclassified a large numbers of subjects (11).

DMS is more objective than the SGA (1). We found that Dialysis malnutrition score was correlated with anthropometric measurements and serum transferrin but the conventional SGA had significant correlation only with anthropometric measurement and not with visceral protein. We, as well as Kalantar-Zadeh *et al.*, found that DMS was significantly correlated with MAMC, MAC, BMI, BSF and TIBC ($P < 0.01$). In other studies it has been shown that DMS is correlated with age, years of hemodialysis, serum albumin level and total protein either singly or in terms of multiple regression analysis (1,6,12,13). There is a lower correlation between SGA with MAMC and TIBC, and no significant correlation between conventional SGA and other parameters (1,13).

Our study did not find correlation with age, duration of hemodialysis and other biochemical indicators of nutrition. However more comparative and longitudinal studies are needed to confirm the validity of this nutrition scoring system. In conclusion, DMS may be more reliable than conventional SGA to identify malnutrition, especially when it is very mild.

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