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The Effect of Nutritional Status on Quality of Life in Patients with Subacute and Early Chronic Stroke: A Pilot Study

Subakut ve Erken Kronik Dönem İnmeli Hastalarda Nütrisyonel Durumun Yaşam Kalitesine Etkisi: Ön Çalışma

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ABSTRACT Objective: The aim of this pilot study was to evaluate the nutritional status of patients with subacute and early chronic stroke, using multidimensional methods such as clinical, biochemical, anthropometric, and ultrasonography (USG) and to determine whether these parameters are related to the quality of life (QoL), and functionality. **Material and Methods:** This cross-sectional study included 33 patients who were hospitalized for stroke rehabilitation between January 2016 and January 2018. The patients were evaluated in respect of nutritional level using biochemical tests, anthropometric measurements [body mass index, arm circumference, triceps skinfold (TSF), leg circumference], and USG. The relationships between the Stroke Impact Scale (SIS) and the biochemical test, anthropometric, and USG measurement results were analyzed. **Results:** The USG measurements of healthy rectus femoris (RF) thickness and healthy RF area were found to be related to the total SIS score (r=0.399, p=0.013; r=0.476, p=0.027 respectively). Anthropometrically, only TSF was associated with the communication subdomain, and total protein, albumin, and creatinine levels were associated with some specific subdomains (p<0.05). Non-hemiparetic RF thickness and area were independent risk factors for total SIS score, serum albumin level was an independent factor for mobility, and serum creatinine level was an independent factor for hand function, and participation (p<0.05). **Conclusion:** The nutritional status of patients with stroke may have an effect on QoL and functionality. Therefore, to be able to improve QoL and functionality, subacute and chronic stroke patients should be evaluated in respect of malnutrition using multidimensional methods such as clinical and biochemical tests, and anthropometric and USG measurements.

Keywords: Hemiplegia; malnutrition; quality of life; stroke; ultrasonography

ÖZET Amaç: Bu pilot çalışmanın amacı, subakut ve erken kronik dönem inmeli hastaların nütrisyonel durumlarını klinik, biyokimyasal, antropometrik ve ultrasonografi (USG) gibi çok boyutlu yöntemlerle değerlendirmek ve bu parametrelerin yaşam kalitesi ve işlevsellik ile ilişkisini incelemektir. **Gereç ve Yöntemler:** Bu kesitsel çalışmaya Ocak 2016 ve Ocak 2018 tarihlerinde inme rehabilitasyonu amacı ile hospitalize edilen 33 hasta dâhil edildi. Hastaların nütrisyonel durumu biyokimyasal testler, antropometrik ölçümler (beden kitle indeksi, kol çevresi, triseps cilt kalınlığı, bacak çevresi) ve USG ile değerlendirildi. İnme Etki Ölçeği [Stroke Impact Scale (SIS)] ile biyokimyasal test, antropometrik ve USG ölçüm sonuçları arasındaki ilişkiler analiz edildi. **Bulgular:** Nonhemiparetik rektus femoris (RF) kalınlığı ve sağlıklı RF alanının USG ölçümleri toplam SIS skoru ile ilişkili bulundu (sırasıyla r=0,399, p=0,013; r=0,476, p=0,027). SIS-iletişim alt grubu ile triseps cilt kalınlığı ve toplam protein, albumin ve kreatinin seviyeleri SIS'nin spesifik alt alanları ile ilişkili bulundu (p<0,05). Nonhemiparetik RF kalınlığı ve alanı toplam SIS skoru için bağımsız risk faktörleriydi, serum albumin seviyesi mobilite için bağımsız bir faktördü ve serum kreatinin seviyesi el fonksiyonu ve katılım için bağımsız bir faktördü (p<0,05). **Sonuç:** İnmeli hastaların nütrisyonel durumu yaşam kalitesi ve fonksiyonelliği etkileyebilir. Bu nedenle yaşam kalitesi ve fonksiyonelliği iyileştirebilmek için subakut ve kronik inmeli hastaların klinik ve biyokimyasal testler, antropometrik ve USG ölçümleri gibi çok boyutlu yöntemlerle malnütrisyon açısından değerlendirilmesi gerekmektedir.

Anahtar Kelimeler: Hemipleji; malnütrisyon; yaşam kalitesi; inme; ultrasonografi

Malnutrition can frequently be seen in the course of neurological diseases. Dysphagia, impaired consciousness, perception deficits, and cognitive dysfunction are common reasons of malnutrition in patients with stroke.[1] Malnutrition is present in up to 49% of patients after stroke. Nutrition deficiency or being at risk of malnutrition increases the risk of poor outcomes and even mortality.[2,3]

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Assessment of the nutritional status in patients with stroke is often difficult because of the lack of a universally accepted definition of malnutrition, and a gold standard for nutritional status assessment. According to the current definitions of malnutrition low muscle masses included, so in recent years in addition to clinical screening tests, anthropometric measurements, and biochemical tests, some methods such as bioelectrical impedance, computed tomography (CT), magnetic resonance imaging, and dual energy X-ray absorptiometry (DXA) have been used in the evaluation of nutritional status.[4,5] Ultrasonography (USG) is considered inexpensive and reasonable for the measurement of muscle thickness in patients with stroke, it has been used in several recent studies of patients with acute stroke.[6]

Nutritional status in stroke patients has been studied mostly in the acute period, and there have been fewer studies of subacute and early chronic stroke patients.[7] With the exception of DXA, magnetic resonance, and CT, which are expensive methods with some radiation exposure, the best method for assessment of the effect of nutritional status on the patient has not yet been defined in practice. Moreover, previous studies have generally evaluated the nutritional status with a single method.

Therefore, the aim of this pilot study was to evaluate the nutritional status of patients with subacute and early chronic stroke using the multidimensional methods of clinical and biochemical tests, and anthropometric and USG measurements, and, to determine whether these parameters are related to quality of life (QoL), and functionality of patients with subacute and early chronic stroke.

MATERIAL AND METHODS

STUDY DESIGN

This pilot study was designed as a cross-sectional study and included 33 patients who were hospitalized for stroke rehabilitation between January 2016 and January 2018.

This study was conducted in accordance with the Declaration of Helsinki guidelines, and the study procedures were approved by the Clinical Trials Ethics Committee of the Health Sciences University Dışkapı Training and Research Hospital (date: September 25, 2017, decision no: 41/16). All participants and their relatives were informed and a signed consent form was obtained from all participants before the study.

PARTICIPANTS

The study included patients with subacute or early chronic stroke with the inclusion criteria of (1) age between 18 and 65 years, (2) the affected side was the dominant side, (3) first ischemic or hemorrhagic stroke, (4) time since the stroke of 31-180 days, (5) upper and lower extremity Brunnstrom stage of ≥2, (6) co-operative cognitive status (Mini-Mental State Examination >24). The clinical staging of stroke is generally accepted as follows: the first 2 weeks are defined as the acute stage; 3-11 weeks post-stroke is termed the subacute stage in which most changes occur; 12-24 weeks post-stroke is the early chronic stage and more than 24 weeks post-stroke is the chronic stage.[8]

Patients were excluded from the study if they had aphasia, subarachnoid hemorrhage, traumatic intracranial hemorrhage, hypoxic-anoxic brain injury, progressive neurological disease, polyneuropathy, psychiatric disorders, severe liver- renal-cardiac deficiency, malignancy, or musculoskeletal disorders such as dislocation, fracture, contracture, amputation or phlebitis on the lower extremity.

DEMOGRAPHIC CHARACTERISTICS

Demographic data including patient age (years), gender, education status, economic level, dominant hand, comorbidities, alcohol use, and smoking status of the patients were recorded.

Education status was classified into 5 groups as illiterate, literate, 5 years education, 8 years education, 11 years education, and more than 11 years education.

The economic level was classified into three levels: (1) low: below the minimum wage, (2) medium: income equivalent to the minimum wage, and (3) high: more than minimum wage.

Alcohol use and smoking status were evaluated as using, not using or quitting. A period of non-use of 10 years or more was recorded as not using.

DISEASE CHARACTERISTICS

Stroke type (ischemic or hemorrhagic), the hemiparetic side, and time since the event were noted. All the patients were evaluated with the Brunnstrom stages of motor recovery for the upper extremity, hand, and the lower extremity (Stages 1 to 6), and carotid and vertebral artery Doppler US (normal, stenosis or hemodynamic stable atheroma plaque).

QoL and functionality of patients were evaluated using the Stroke Impact Scale 3.0 (SIS).

The SIS 3.0 evaluates 8 domains of health: strength, hand function, memory, communication, emotion, and social participation.[9] The combinations of strength, hand function, daily living activities, and mobility are also considered a composite physical domain.[6] Scores for each domain range from 0 to 100, with higher scores showing a better QoL. The SIS is more sensitive in the determination of the motor function in patients with stroke who have been classified as "minimal" or "no disability". The SIS was translated to Turkish by Hantal et al.[9]

The Gugging Swallowing Screening (GUSS) test was used to evaluate dysphasia. The GUSS test evaluates swallowing with a possible total of 20 points as follows: 0-9 points: severe dysphagia with a high aspiration risk; 10-14 points: moderate dysphagia with moderate aspiration risk, 15-19 points: slight dysphagia with low aspiration risk, and 20 points: no dysphagia.[10,11] The validity and reliability of the Turkish version of this scale were demonstrated by Umay et al.[10,11]

NUTRITIONAL EVALUATIONS

Clinical Screen Test

Nutritional risk screening was performed using the Nutrition Risk Screening-2002 (NRS-2002). Nutritional risk is identified by investigating disease severity, weight loss, body mass index (BMI), and food intake. A final score of ≥3 indicates that the patient is at risk of malnutrition.[8]

Biochemical Tests

Laboratory test parameters that may be associated with nutritional levels such as albumin, prealbumin, transferrin, hemoglobin, hematocrit, total protein, blood urea nitrogen, creatinine, iron, total cholesterol, 25(OH) vitamin D, calcium, potassium, aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase were noted from the results of the first day.

Anthropometric Measurements

Four anthropometric measurements for investigating the nutritional status were selected as index tests in this study: BMI, arm circumference (AC), triceps skinfold (TSF), and leg circumference (LC). The AC was measured from the middle point of the line between the acromion and olecranon, and TSF was determined using anthropometric calipers at the same point. The midpoint of the line between the spina iliac anterior and upper end of the patella was the point at which LC was measured. Other than BMI, the anthropometric evaluations were performed bilaterally.

Ultrasonographic Evaluation

All ultrasonographic evaluations were made by the same single observer with the patient lying supine and using a 10-12 mHz linear probe (GE Logiq P5, General Electric Korea). The deltoid, biceps brachii, forearm flexors, rectus femoris (RF), lateral head of the gastrocnemius, tibialis anterior, and extensor digit or umbrevis were investigated. The area of all these muscles was assessed bilaterally. Muscle USG was obtained 3 times for each muscle. Then, the average of the 3 measurements was calculated. Ultrasonographic evaluations of the muscle area were performed for the deltoid from below the acromion, for the biceps brachii from 30% proximal between the acromion and olecranon, for the forearm flexors from the midpoint between the elbow antecubital fossa and the distal line of the wrist, for the gastrocnemius and tibialis anterior from 30% proximal between the lateral malleolus and lateral tibial condyle, and for the RF from the midpoint between the spina iliac anterior and the patella. RF thickness was measured at the same point as the RF area.[12,13]

Comparisons

All evaluations were performed on the first day of hospitalization. After the anthropometric and USG measurements of both the hemiparetic and intact sides, a ratio of <1 between the hemiplegic side and the non-hemiparetic side was considered nutritional deficiency (for anthropometry) and loss of muscle mass (for USG). This definition was applied as it has been reported in the literature that the muscle size of the dominant extremity is expected to be more than that of the non-dominant extremity.[14,15] The patients included in this study were those with hemiplegia on the dominant side. Functional level and QoL were evaluated using the SIS correlated with the biochemical tests, anthropometric, and US measurement results.

STATISTICAL ANALYSIS

Data obtained in the study were analyzed statistically using the SPSS (SPSS 25.0 for Windows IBM Corp., Armonk, NY, USA) software. In descriptive statistics, the data were expressed as mean±standard deviation for continuous variables and as frequencies and percentages (%) for nominal variables using χ^2 test. The Kolmogorov-Smirnov test was used to assess the normality of data distribution. Correlations between evaluation parameters and SIS were analyzed with the Pearson's correlation test. Simple linear regression in univariate analysis was applied for the evaluation of correlations between SIS total and subscale scores (dependent variables), and parameters with significant correlation in correlation analysis (independent variables). Accordingly, first a regression equation model was formed as y=mx+b (m=slope, b=intercept). The values of "a" and "b" were calculated with the least squares method.[16] Values of $p<0.05$ were considered statistically significant.

RESULTS

The evaluation was made of 33 patients, comprising 19 (57.6%) males and 14 (42.4%) females with a mean age of 62.72±11.81 years. The demographic characteristics of the patients are shown in Table 1. The most common comorbidity was hypertension, followed by diabetes mellitus, cardiac diseases, and hyperlipidemia (Table 1).

Disease characteristics are shown in Table 2. The mean time since the event was 54.66±58.33 days. Stroke type was evaluated as ischemic in 26 (78.8%) patients and hemorrhagic in 7 (21.2%). The hemiparetic side was right-side in 18 (54.5%) patients and left-side in 15 (45.5%). There was no aspiration risk in 24 (72.7%) patients, 9 (27.3%) patients had mild aspiration risk, and there were no cases of moderate or severe aspiration risk.

TABLE 1: Demographic characteristics of patients.

Demographic characteristics	n=33
Gender n (%)	
Male	19 (57.6)
Female	14 (42.4)
Age (years) X±SD	62.72±11.81
Education n (%)	
Not illiterate	5 (15.2)
Literate	1 (3.0)
5 years education	21 (63.6)
8 years education	0
11 years education	2 (6.1)
Over 11 years education	4 (12.1)
Using alcohol n (%)	
Using	5 (15.2)
Not using	28 (84.8)
Using cigarette n (%)	
Using	12 (36.4)
Not using	21 (63.6)
Comorbidities n (%)	
HT	27 (81.8)
DM	18 (54.5)
Cardiac disease	12 (36.4)
Hyperlipidemia	9 (27.3)

SD: Standard deviation; HT: Hypertension; DM: Diabetes mellitus.

The mean NRS-2002 clinical evaluation test score was 1.50 (1.32±0.78), indicating no nutritional deficiency in any patient. With the exception of 25(OH) vitamin D, the other biochemical test results were in the normal range for each parameter. The mean 25(OH) vitamin D level of 16.07±14.37 was below the normal range.

All the ratios of the hemiparetic/non-hemiparetic results of the anthropometric and USG evaluations were <1.

The significant correlations with SIS and the results of all the biochemical, anthropometric measurements, and USG evaluations are shown in Table 3, and the regression analysis results are presented in Table 4.

Some biochemical tests were positively moderately correlated with some domains of SIS, including

TABLE 2: Disease characteristics of patients.

	n=33 n (%), X̄±SD
Time since the event (days)	54.66±58.33
Stroke type	
Ischemic	26 (78.8)
Hemorrhagic	7 (21.2)
Hemiparetic side	
Right	18 (54.5)
Left	15 (45.5)
Carotid and vertebral artery doppler ultrasonography	
Hemodynamic stabil atheroma plaque	25 (75.8)
Stenosis	8 (24.2)
Brunstroom level (1-6)	
Hand	2.69±1.68
Upper extremity	2.81±1.57
Lower extremity	3.72±1.44
SIS (0-100)	
Strength	27.29±20.85
Memory&thinking	61.12±22.15
Emotions	40.03±14.91
ADL/IADL	22.66±14.04
Communication	59.99±18.01
Mobility	27.60±25.29
Hand function	5.51±8.89
Participation	13.86±11.63
Stroke recovery	49.39±18.53
Total score	38.43±13.73
Composite physical domain	83.07±52.92
GUSS	
No dysphagia (>20)	24 (72.7)
Low aspiration risk (15-19)	9 (27.3)
Moderate aspiration risk (10-14)	0
Sever aspiration risk (0-9)	0

SD: Standard deviation; NIHSS: National Institutes of Health Stroke Scale; SIS: Stroke Impact Scale; ADL: Activities of daily life; IADL: Instrumental activities of daily living; GUSS: Gugging swallowing screening.

serum albumin level with mobility (r=0.377, p=0.015), and serum creatinine level with hand function (r=0.354, p=0.022), and participation (r=0.480, p=0.002), and serum total protein with the total score (r=0.308, p=0.040). In the anthropometric measurements, only the hemiparetic TSF was negatively moderately correlated with the communication subdomain of SIS (r=0.404, p=0.013) (Table 3).

Negative moderate correlations were demonstrated with the subdomain of strength and ratio of hemiparetic/non-hemiparetic LC, subdomain of communication and ratio of hemiparetic/non-hemiparetic deltoid thickness, subdomain of mobility and ratio of hemiparetic/non-hemiparetic RF thickness, and subdomain of stroke recovery and the ratio of hemiparetic/non-hemiparetic biceps thickness. (r=-0.366, p=0.021; r=0.410, p=0.010; r=0.479, p=0.026; r=0.415, p=0.010, respectively). Positive moderate correlations were detected between non-hemiparetic RF thickness, non-hemiparetic RF area, and SIS total score (r=0.399, p=0.013; r=0.476, p=0.027 respectively) (Table 3).

In regression analysis, it was observed that non-hemiparetic RF thickness and area were independent risk factors for the total SIS score, serum albumin level was an independent factor for mobility, and serum creatinine level was an independent factor for hand function and participation (p<0.05) (Table 4).

DISCUSSION

The aim of this pilot study was to evaluate the nutritional status of patients with subacute and early chronic stroke using the multidimensional methods of clinical and biochemical tests, and anthropometric and USG measurements, and to determine whether these parameters affected the QoL and functionality of patients.

The results of the study demonstrated that while the nutritional status of the subacute and chronic stroke patients was evaluated as normal (no malnutrition) according to the clinical screening test and biochemical parameters, with the exception of 25(OH) vitamin D, malnutrition was determined according to the anthropometric and ultrasonographic evaluations, except BMI. As a result of evaluating the relationships between all the parameters and QoL, healthy RF thickness and RF area measured ultrasonographical were found to be independent risk factors for the total QoL score. Anthropometrically, only TSF was associated with the communication subdomain and total protein, albumin and creatinine levels were associated with some specific subdomains (total protein: daily life activities, albumin: mobility, creatinine: social participation and hand functions).

Screening tests usually aim to determine the risk of malnutrition in hospitalized patients, in the early stages of the disease. The nutritional status of the cur-

TABLE 3: Significant correlations of the Stroke Impact Scale and evaluation parameters.

	SIS-strength subdomain	
	r	**p value**
Ratio of hemiparetic/no hemiparetic leg circumference	-0.366	0.021
Non-hemiparetic RF area	0.557	0.010
Hemiparetic RF area	0.497	0.021
	SIS-memory&thinking subdomain	
	r	**p value**
Non-hemiparetic RF thickness	0.365	0.022
Non-hemiparetic RF area	0.532	0.014
	SIS-emotions subdomain	
	r	**p value**
Non-hemiparetic RF thickness	0.548	0.001
Non-hemiparetic RF area	0.574	0.008
Hemiparetic RF area	0.538	0.013
	SIS-ADL/IADL subdomain	
	r	**p value**
Non-hemiparetic RF thickness	0.350	0.027
Level of total protein	0.410	0.009
	SIS-communication subdomain	
	r	**p value**
Ratio of hemiparetic/no hemiparetic deltoid thickness	-0.410	0.010
Non-hemiparetic RF thickness	0.348	0.028
Hemiparetic triceps skin fold	0.404	0.013
	SIS-mobility subdomain	
	r	**p value**
Ratio of hemiparetic/no hemiparetic RF thickness	-0.479	0.026
Level of albumin	0.377	0.015
	SIS-hand function subdomain	
	r	**p value**
Level of creatine	0.354	0.022
	SIS-participation subdomain	
	r	**p value**
Level of creatine	0.480	0.002
	Stroke recovery	
	r	**p value**
Ratio of hemiparetic/no hemiparetic biceps thickness	-0.415	0.010
	SIS-total score	
	r	**p value**
Non-hemiparetic RF thickness	0.399	0.013
Non-hemiparetic RF area	0.476	0.027
Hemiparetic RF area	0.465	0.030
Level of total protein	0.308	0.040
	SIS-composite physical domain	
	r	**p value**
Hemiparetic RF area	0.494	0.022

r: Correlation coefficient; SIS: Stroke Impact Scale; RF: Rectus femoris; ADL: Activities of daily living; IADL: Instrumental activities of daily living.

rent study patients was found to be normal according to NRS-2002. This may be related to the inclusion of subacute and chronic stroke patients with stable or compensated nutritional status in this study. Although this test has been reported to be effective, valid, and reliable for the acute period, it may not be suitable

TABLE 4: Regression analyses results of significant correlations.

	n=33			
SIS (0-100)	**B**	**SE**	**%95 CI**	**p value**
Strength				
Ratio of hemiparetic/no hemiparetic leg circumference	-5.17	11.12	-17.58-27.93	0.043
Non-hemiparetic RF area	8.61	3.31	1.55-15.67	0.020
Hemiparetic RF area	8.11	3.66	1.31-15.92	0.042
Memory&thinking				
Non-hemiparetic RF thickness	12.83	6.08	1.39-25.27	0.044
Non-hemiparetic RF area	10.85	4.46	1.34-20.36	0.028
Emotions				
Non-hemiparetic RF thickness	12.73	6.12	5.34-20.12	0.001
Non-hemiparetic RF area	8.35	3.05	1.78-14.82	0.016
Hemiparetic RF area	8.23	3.32	1.14-15.32	0.026
ADL/IADL				
Non-hemiparetic RF thickness	7.40	3.67	1.12-14.91	0.043
Level of total protein	11.52	5.48	2.14-20.89	0.018
Communication				
Ratio of hemiparetic/no hemiparetic deltoid thickness	-17.50	6.64	-2.89-32.11	0.021
Non-hemiparetic RF thickness	9.94	4.99	1.23-20.21	0.048
Hemiparetic triceps skin fold	1.41	0.54	0.17-2.65	0.027
Mobility				
Ratio of hemiparetic/no hemiparetic RF thickness	-27.18	12.85	-1.20-54.58	0.049
Level of albumin	22.50	9.94	2.23-42.77	0.031
Hand function				
Level of creatine	5.65	2.68	0.18-11.12	0.043
Participation				
Level of creatine	10.03	3.29	3.32-16.74	0.005
Stroke recovery				
Ratio of hemiparetic/no hemiparetic biceps thickness	-35.25	14.36	-64.62-5.87	0.020
Total score				
Non-hemiparetic RF thickness	8.48	3.62	1.07-11.88	0.026
Non-hemiparetic RF area	5.27	2.52	1.09-10.64	0.048
Hemiparetic RF area	5.45	2.68	0.26-11.16	0.060
Level of total protein	8.46	4.69	-1.10-18.03	0.081
Composite physical domain				
Hemiparetic RF area	20.57	9.64	0.67-40.47	0.044

SIS: Stroke Impact Scale; B: Regression coefficient; SE: Standard error; CI: Confidence interval; RF: Rectus femoris; ADL: Activities of daily living; IADL: Instrumental activities of daily living.

for patients in the chronic period, as in the current study patient profile.[17]

In a previous study, the nutritional status of 201 acute stroke patients was evaluated from anthropometric, hematological, and biochemical measurements. Serum albumin concentration was reported as a good predictor of the level of disability and a strong and independent predictor of mortality.[18] In the current study, all biochemical parameters except vitamin D were found to be within normal limits and were not associated with the total stroke QoL score. Only total protein (daily life activities), albumin (mobility), and creatinine (hand functions and social participation) levels were found to be associated with some subscales. Albumin concentration does not specifically indicate malnutrition. In addition, the catabolic state and neuroendocrine response, which commonly follow an acute stroke, may be other reasons for the altered serum albumin concentrations. However, when metabolic instability was eliminated, its effectiveness could not be demonstrated in the subacute and chronic periods.

In a study by Serra et al., these biochemical parameters and BMI were shown not to affect the functionality of the patient.[19] It was stated that biochemical evaluation and BMI were not appropriate evaluation methods for patients in the chronic period, similar to the current study results.

In another study evaluating the relationship between QoL and biochemical parameters and BMI in patients with chronic stroke, Jönsson AC et al. noted albumin and prealbumin values as biochemical parameters and BMI levels as anthropometric.[20] The results of that study showed that prealbumin levels are related to the Barthel index score. Unlike the current study, the patients had lower BMI levels and it was thought that this could have been related to the presence of dysphagia. None of the current study patients had any serious uncompensated swallowing difficulties. Based on these results, it can be thought that although dysphagia is associated with possible early malnutrition, there is no dominant effect in the subacute and chronic periods. In the literature, it has been shown that in the acute period, dysphagia is an independent, major risk factor for malnutrition in patients with stroke.[21] However, there are no data on this point for the subacute and chronic periods.

Previous studies have demonstrated that chronic stroke patients have a lower level of serum vitamin D than healthy control subjects.[22] In a study which measured vitamin D levels in 50 subacute and chronic stroke patients, it was found that patients with independent ambulation had higher levels of vitamin D than those who were not capable of independent walking.[23] However, according to the present study results, although vitamin D levels were low, no relationship was determined with any QoL subscales. This may have been because there was no patient with lower extremity Brunnstrom motor stage ≤2, so the effects that may occur due to immobilization were not seen.

In the current study, in addition to the commonly used BMI, anthropometric measurements such as AC, TSF, and LC were also performed, as a result of the comparison between the healthy and hemiplegic sides, all patients were found to have decreased values on both sides, but more so on the affected side.

It has been reported in the literature that circumference and skinfold thickness measurements are generally related to the patient's subcutaneous fat ratio, may decrease without being associated with BMI for energy supply, and may reflect nutritional status.[24] In a previous study of stroke patients, skinfold thickness and circumference measurements were reported to be lower in functionally assisted mobilized patients than in immobile patients, as the need for energy increases more.[25]

In a study which investigated whether anthropometric measurements of the non-paralyzed extremity may be useful for malnutrition scanning in older patients with stroke, it was seen that stroke patients with lower measurements had significantly worse functional and discharge outcomes compared to the patients with higher measurement values.[26]

According to these data, bilateral anthropometric measurements may reflect nutritional status. In contrast to the literature, the current study results showed that anthropometric measurements were not related to total stroke QoL, but when the subgroups were considered, low triceps skin thickness level was associated with the communication subscale. The low skinfold thickness of these patients may also be related to the severity and location of neurological damage and cannot be explained only by an increase in energy deficit. It also showed that the relationship between the LC measurement and the strength subdomain was not only associated with the level of subcutaneous adipose tissue but also with the structure of the muscle. Structural changes occur in skeletal muscle post-stroke. Disuse following stroke is usually reported as the most common cause of structural changes such as muscle atrophy.[27] Following a stroke, patients may have muscle atrophy in both the paretic and non-paretic limbs. Some studies have found that atrophy, fatty infiltration, and fibrous tissue in the paretic side muscles were more common than on the non-paretic side.[28,29]

In accordance with the literature, as a result of the ultrasonographic evaluation in the current study, it was found that all the ultrasonographic measurement parameters in the upper and lower extremities decreased more on the hemiplegic side compared to the healthy side, and that total stroke QoL was associated with the healthy side RF thickness and area.

There have been very few studies in which muscle measurements of stroke patients have been taken with USG. Berenpas et al. investigated bilateral structural changes in the extremity muscles of 28 physically active patients with chronic stroke using quantitative muscle ultrasound.[30] It was reported that abnormalities can be found in muscles on the paretic as well as on the non-paretic side after stroke when compared to reference values obtained from healthy control subjects and muscle USG is a useful technique to investigate structural changes in extremity muscles in the chronic period of stroke. In another study by Nozoe et al. 52 patients with subacute stroke were evaluated in respect of the relationship between functional disability and quadriceps thickness measured with USG.[5] The ultrasonographic muscle measurement was found to be associated with a functional disability on both the non-paretic and paretic sides and was stated to be a valid method to assess muscle wasting and physical function in these patients.

The most important limitations of this pilot study were that it was cross-sectional in design, the small sample size and that there was no control group. The low number of patients was due to the inclusion criterion of the hemiparetic side being the dominant side. Another limitation was the lack of evaluation of muscle structure and the relationship of this parameter with QoL.

However, strong aspects of the study were that malnutrition was evaluated with several methods. Anthropometric and ultrasonographic evaluations were made not only of the hemiparetic side but also of the healthy, unaffected side.

CONCLUSION

According to the results of this study in which malnutrition in subacute and early chronic stroke patients was assessed with biochemical, anthropometric, and ultrasonographic methods, it was seen that the USG measurements of lower extremity muscles on both the healthy and paretic sides, anthropometric measurements of hemiparetic upper extremities, and some biochemical measurements can be effective on QoL and functionality of patients with subacute or chronic stroke. Therefore, for the assessment of malnutrition in subacute and early chronic stroke patients, multidimensional methods such as clinical, biochemical, anthropometric and USG methods should be evaluated and treatments applied for the improvement of QoL and functionality.

There is a need for further studies with larger samples to confirm these results and be able to draw more robust conclusions.

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