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Frailty and Sarcopenia in Patients With Distal Radius Fracture: A Geriatric Perspective

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Abstract

Introduction: Sarcopenia, which is described as loss of muscle mass and function, worsens daily living activities of older people. Sarcopenia is a component of frailty that causes falls and fractures in older people. The aim of this study was to evaluate sarcopenia and frailty status of older people with distal radius fracture (DRF) and compare with age- and sex-matched controls without DRF. **Materials and Methods:** This is an observational cross-sectional study including 27 patients with DRF and 28 controls without fracture who applied to geriatric outpatient clinic. Sarcopenia was diagnosed according to the definition of European Working Group on Sarcopenia in Older People 2. Frailty was assessed by Fried frailty index. Comprehensive geriatric assessment was applied to all participants. **Results:** Median ages were 70 and 69 years (min: 65, max: 87 in both) in patients with DRF and controls, respectively. The prevalence of sarcopenia was similar between the groups ($P = .48$). Prefrail–frail (nonrobust) phenotype was higher in patients with DRF ($P = .04$). Nonrobust phenotype was an independent variable predicting DRF in logistic regression models. **Discussion:** This study showed that nonrobust phenotype was an independent variable predicting DRF. **Conclusion:** Assessment of frailty and detecting patients with nonrobust phenotype may help clinicians in fracture prevention strategies.

Keywords

fracture, frailty geriatrics, sarcopenia

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Introduction

In older people, most common upper extremity fracture is distal radius fracture (DRF). Distal radius fracture with higher incidence in women is a serious public health concern.[1] This type of fracture usually results from low-energy traumas such as a fall during daily activities. Osteoporosis is leading cause of DRFs. Other risk factors are female sex, ethnicity, heredity, previous fracture history, and early menopause.[2]

Sarcopenia is a condition of decrease in muscle mass and function affecting older people by decreasing daily living activities and consequently leading to frailty and falls.[3,4] Regardless of bone density, sarcopenia has been shown as an independent risk factor for fragility fractures.[5,6] Roh et al[6] showed that sarcopenia rates were higher in patients with DRF than age- and sex-matched controls. In contrast to that study, Lee et al[7] demonstrated that appendicular lean mass and sarcopenia rates were not significantly different between patients with DRF and age- and sex-matched controls. Nevertheless, these studies defined sarcopenia according to only dual-energy X-ray absorptiometry (DEXA) results, other sarcopenia components demonstrating muscle function (handgrip strength, walking time) have not been considered.

Frailty is a status of decreased reserve and resistance to stress resulting from multiple age-related physiologic changes, such as decline in lean body mass, strength, physical performance, balance, and endurance causing vulnerability.[8,9] Frailty is a high-risk factor for adverse health outcomes, such as falls, mortality, hospitalization, and instutionalization.[10]

Outcomes from previous studies analyzing relation between sarcopenia and DRF are controversial. Sarcopenia rates were different, while bone mineral density values of DRF groups

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were lower in both the studies. These findings may suggest that a risk factor other than sarcopenia and osteoporosis may play a role in DRFs. We hypothesized that patients with DRF are more frail and/or sarcopenic than age- and sex-matched controls. The aim of this study is to investigate relationship between frailty, sarcopenia, and DRFs.

Materials and Methods

The study was approved by Hacettepe University Ethics Committee (reference number: GO 18/513-12) and it was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from each participant. Patients with DRF who were treated nonsurgically in Numune Training and Research Hospital recruited from June 2018 to December 2018. Patients aged 65 years and older with acute DRF treated within 10 days after injury caused by fall on hands were included. Patients with cognitive impairment, multiorgan injury, and neuromuscular impairment of any chronic debilitating disease such as Parkinson, stroke, and renal insufficiency were excluded. Patients with DRF who agreed to participate in study were evaluated by a geriatrician in Hacettepe University Hospital within 15 days after injury. Healthy controls who had no wrist problems were selected from patients who visited outpatient clinics of Hacettepe University Hospital for routine examination. Controls were age and sex matched with patients with DRF and had no specific disease, except regulated hypertension and diabetes mellitus.

Comprehensive geriatric assessment was applied to all participants. Mini-Mental State Examination (MMSE) scale which is composed of 30 statements was used to evaluate cognitive status. Mini-Mental State Examination is scored from 0 to 30 points.[11,12] Functional status was assessed using KATZ basic activities of daily living (bathing, dressing, toileting, transfer, feeding, continence) and Lawton-Brody instrumental activities of daily living (telephone use, housekeeping, laundry, medication use, transportation, preparing meal, shopping, handling finances) tests. KATZ and Lawton-Brody scales are scored between 0 to 6 and 0 to 8 points, respectively.[13-15] Emotional status was evaluated via Yesavage Geriatric Depression Scale (Yesavage GDS), which consists of 15 questions and is scored between 0 and 15 points.[16,17] Mini-Nutritional Assessment-Short Form (MNA-SF) was applied to all participants. The MNA-SF shows nutritional status of individual and is scored between 0 and 14 points.[18,19]

Hemoglobin, albumin, calcium, phosphorus, vitamin B12, and 25-OH vitamin D3 results in the previous 15 days were recorded. Chronic medical diseases such as controlled hypertension and diabetes mellitus, coronary artery disease, and depression were registered. The participants underwent DEXA to evaluate bone mineral density. Bone mineral density was categorized by the World Health Organization criteria. Osteoporosis was defined as T score of the femoral neck, total femur, or total lumbar spine ($L_{1\text{-}4}$) ≤ -2.5 standard deviation of young adults.[20]

Weight (kg) and height (cm) were measured while patients were wearing light clothes without shoes. Body mass index (kg/m^2) was calculated.

Sarcopenia was diagnosed according to definitions of European Working Group on Sarcopenia in Older People 2 (EWGSOP2).[21] Probable sarcopenia was defined as low muscle strength. If low muscle quantity or quality accompanied to low muscle strength, sarcopenia was confirmed. "Severe sarcopenia" was considered if low muscle strength, quantity or quality, and performance exist simultaneously.

Muscle strength was evaluated by hand grip strength. Isometric grip strength was assessed for unaffected hand and measured using a manual Takei handgrip dynamometer (Takei model 5101 TKK, digital, nonstatic handle, Japan) with the forearm at neutral position and elbow flexed at 90°. Adjustment of hand dominance was made according to rule that the dominant hand is approximately 10% stronger than the nondominant hand for right-handed patients. Strength of left hand was multiplied by 1.1 for adjustment of hand dominance.[22] Patients had 3 trials, with at least 30 seconds resting intervals between measurements. The maximum grip strength was recorded as kilograms. Reduced grip strength cutoff point was <27 kg for men and <16 kg for women according to EWGSOP2.[20]

Gait speed was used for assessment of muscle performance. Participants were asked to walk 4 m with usual speed. If walking speed was less than 0.8 m/s, it was accepted as reduced muscle performance.[21]

Bioelectric impedance analysis was used for estimation of total body muscle mass. Bioelectric impedance analysis measurements are reliable and correlated with magnetic resonance imaging results. Skeletal muscle mass index (SMI) was used for estimating muscle mass. Fat-free mass (FFM) were measured with BodyStat Quadscan 4000 bioimpedance analyzer (BodyStat Ltd, Douglas, Isle of Man, British Isles) while patient in a supine position after an overnight fast. Four electrodes were placed at the dorsum of the right hand and right wrist and dorsum of the right foot and right ankle. Skeletal muscle mass index was calculated as follows: SMI = (FFM × 0.566 [kg])/height $(m)^2$. Cutoff point for SMI in our population was accepted <9.2 kg/m^2 for men and <7.4 kg/m^2 for women.[23]

Frailty status was defined according to Fried frailty index.[24] Fried frailty index was composed of 5 items: weight loss, exhaustion, low physical activity, decreased walk time, and grip strength. If 3 items are present in the patient, it is defined as "frail." If 1 or 2 items are present, it is defined as "prefrail." If none of the items are present in the patient, it is accepted as "robust." We categorized patients into 2 groups while performing statistical analyses. According to Fried frailty index, robust patients were categorized as robust and prefrail and/or frail patients were categorized as nonrobust.

Results

We requested to 60 patients with DRF to participate in the study. Thirty-one patients agreed to participate. Response rate was 51.6%. Three patients with prosthesis and 1 patient with

Table 1. General Characteristic Features of the Groups.[a]

	Patients With DRF, n = 27	Patients Without DRF, n = 28	*P*
Age	70 (65-87)	69 (65-87)	.96
Gender (female/male)	20/7	20/8	.82
KATZ	6 (5-6)	6 (4-6)	.04
Lawton-Brody	8 (2-8)	8 (2-8)	.50
MMSE	28 (10-30)	29 (22-30)	.69
Yesavage GDS	3 (0-8)	2 (0-9)	.04
MNA-SF	14 (8-14)	13 (6-14)	<.01
Number of drugs	2 (0-9)	3 (0-12)	.45
SMI (kg/m^2)	9.6 (7.5-12.3)	9.9 (3.4-14.2)	.40
Gait speed (m/s)	1.23 ± 0.34	1.17 ± 0.44	.58
Grip strength (kg)	20.3 ± 5.2	20.5 ± 6.8	.93
BMI (kg/m^2)	28.2 ± 4.9	27.9 ± 6.7	.86
Calcium (mg/dL)	9.39 ± 0.36	9.62 ± 0.49	.06
Albumin (mg/dL)	4.06 ± 0.28	4.23 ± 0.30	.04
Phosphorus (mg/dL)	3.65 ± 0.48	3.50 ± 0.39	.23
25-OH-vitamin D3 (μg/L)	14 (5-40.4)	16.5 (5.4-45)	.22
Hemoglobin (g/dL)	13.05 ± 1.58	13.34 ± 1.77	.58
Vitamin B12 (pg/mL)	175 (89-449)	211 (29-1500)	.15
Lumbar BMD (g/cm^2)	0.924 ± 0.148	0.956 ± 0.134	.40
Total femur BMD (g/cm^2)	0.824 ± 0.140	0.891 ± 0.161	.10
Femur neck BMD (g/cm^2)	0.716 ± 0.132	0.759 ± 0.106	.18

Abbreviations: BMD, bone mineral density; BMI, body mass index; DRF, distal radius fracture; GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination; MNA-SF, Mini Nutritional Assessment–Short Form; SMI, Skeletal muscle mass index.
[a]Data were presented as median (minimum-maximum) for nonparametric variables and mean ± standard deviation for parametric variables.

cardiac pill were excluded from the study. Finally, 27 patients with DRF were included in the study. Twenty-eight control patients without DRF were recruited. Seven patients with DRF and 8 controls without DRF were male. Median ages were 70 and 69 years (min: 65, max: 87 in both) in patients with DRF and controls, respectively. In the DRF group, 29.6% (n = 8) of patients were uneducated, 48.1% (n = 13) were primary school educated, 3.7% (n = 1) were secondary school, 7.4% (n = 2) were high school, and 11.1% (n = 3) were university educated. In the control group, 25% (n = 7) of patients were uneducated, 57.1% (n = 16) were primary school, 7.1% (n = 2) were secondary school, 3.6% (n = 1) were high school, and 7.1% (n = 2) were university educated. In the DRF group, 55.6% (n = 15) of patients were living with spouse, 25.9% (n = 7) were living with their sons/daughters, and 18.5% (n = 5) were living alone. In control group, 64.3% (n = 18) of patients were living with spouse, 32.1% (n = 9) were living with their sons/daughters, and 3.6% (n = 1) were living alone.

General characteristics of groups are presented in Table 1. Medical diseases, sarcopenia, and frailty states of groups are presented in Table 2. Two of the patients included in study were found to be sarcopenic and both of them were in the control group. There was not statistically significant difference between the groups ($P = .49$). Results of logistic regression analysis are summarized in Table 3.

Table 2. Prevalence of Medical Conditions, Sarcopenia, and Frailty Among the Groups.

Medical Conditions	Patients With DRF, %, n = 27	Patients Without DRF, %, n = 28	*P*
Probable sarcopenia (n)	29.6 (8)	39.3 (11)	.45
Frail phenotype[a] (n)	7.4 (2)	7.1 (2)	.97
Nonrobust phenotype[b] (n)	70.4 (19)	42.9 (12)	.04
Diabetes mellitus (n)	25.9 (7)	32.1 (9)	.61
Hypertension (n)	66.7 (18)	64.3 (18)	.85
CAD (n)	11.1 (3)	14.3 (4)	.72
Depression (n)	22.2 (6)	17.9 (5)	.68
Osteoporosis (n)	40.7 (11)	39.3 (11)	.91

Abbreviations: CAD, coronary artery disease; DRF, distal radius fracture.
[a]According to fried frailty phenotype.
[b]Nonrobust phenotype represents frail and/or prefrail patients according to Fried frailty index.

Table 3. Independent Variables Predicting Distal Radius Fractures by Logistic Regression Analysis.[a,b,c,d]

Models	Independent Variables	OR	95% CI	*P*
Model 1	Nonrobust phenotype	3.16	1.039-9.654	.04
Model 2	Nonrobust phenotype	3.16	1.039-9.654	.04
Model 3	Nonrobust phenotype	4.25	1.255-14.403	.02
	Serum calcium level	0.21	0.052-0.853	.02
Model 4	Nonrobust phenotype	4.62	1.318-16.263	.01
	Serum calcium level	0.17	0.039-0.750	.01

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]Model 1: Age, serum 25-OH vitamin D3 level, probable sarcopenia (categorical variable), nonrobust phenotype (categorical variable), and osteoporosis (categorical variable).
[b]Model 2: Age, sex, serum 25-OH vitamin D3 level, osteoporosis (categorical variable), and nonrobust phenotype (categorical variable).
[c]Model 3: Age, serum 25-OH vitamin D3 level, serum calcium level, osteoporosis (categorical variable), and nonrobust phenotype (categorical variable).
[d]Model 4: Age, osteoporosis (categorical variable), serum calcium level, serum phosphorus level, and nonrobust phenotype (categorical variable).

Discussion

Previous studies have indicated contradictory results concerning the association between the presence of sarcopenia and DRFs in older people.[6,7] However, the association between sarcopenia, DRFs, and frailty has not been investigated. Our study showed that sarcopenia and frailty rates were similar in patients with DRF and age- and sex-matched controls. Nonrobust phenotype was higher in patients with DRF than controls. Walking time, handgrip strength, and FFM index were not significantly different in both groups.

The prevalence of sarcopenia defined according to EWGSOP2 criteria changes from 1% to 29% in community-dwelling people older than 50 years.[25] In our study, the prevalence of sarcopenia was 3.6% (n = 2) in all study population.

Roh et al[6] demonstrated that sarcopenia was more prevalent in patients with DRF and they found that patients with DRF had

lower appendicular lean mass and weaker grip strength. Participants included in the former study were 50 years and older. In our study, there were no significant difference in sarcopenia rates and components such as SMI, hand grip strength, and walking time. Moreover, although there was no statistically significant difference between the groups, our control group was more sarcopenic. This may be resulted from lower KATZ and MNA-SF scores. Because lower KATZ score indicates dependency in basic daily living activities and lower MNA-SF score may be related to sarcopenia. Although patients without medical diseases other than regulated diabetes mellitus and controlled hypertension were selected, control group included more sarcopenic and dependent patients.

The prevalence of frailty based on Fried frailty index varies between 7% and 11% of people aged 65 years and older and 25% to 40% of people 80 years and older.[26] In our study, frailty prevalence was 7% and prevalence of prefrail patients was 56.4% among all study population. This is a similar result with previous literature. Previous reviews showed that frailty is a significant risk factor for fractures and fracture risk increased even in prefrail patients.[26,27] However, the rate of frail phenotype was similar in DRF and control groups in our study. But the rate of prefrail phenotype was significantly higher in patients with DRF. Additionally, logistic regression analysis showed that nonrobust phenotype was an independent variable predicting DRF in 4 different models, including age, sex, 25-OH vitamin D3, serum calcium level, serum phosphorus level, probable sarcopenia, nonrobust phenotype, and osteoporosis.

Functional and cognitive capacity declines and medical diseases increase with aging. Therefore, evaluation of older patients should include multidomain tasks.[28,29] In our study, cognitive function and instrumental daily living activities measured by MMSE and Lawton-Brody scales, respectively, were similar in DRF and control groups. Basic daily living activities and psychological and nutritional states were significantly different in both groups. Our geriatric assessment results, except KATZ, MNA-SF, and Yesavage GDS, show that all patients included in study had similar geriatric characteristics. Furthermore, median ages and rates of diabetes mellitus, hypertension, and coronary artery disease were similar in both the groups. All the similarities mentioned strengthened our study.

There were some limitations in our study. Study population included was small because of limited study time, which was 7 months from June 2018 to December 2018. Proportion of male patients was lower than female patients. Further studies including more male patients and wider populations are needed. According to our observations, patients with DRFs had experienced their fall, which caused to radius fracture during moderate activity such as housekeeping and walking at the outdoor. This suggests that most of these patients had moderate activity in daily life. However, our control group was recruited from our geriatrics outpatient clinic and usually patients applying to any geriatrics unit are generally more dependent, inactive in daily life, and have some complaints that lead them to hospital admission. Therefore, our control group may have been more sarcopenic and dependent due to reasons mentioned before, although age and prevalence of chronic medical conditions were similar.

Conclusion

The present study showed that the prevalence of nonrobust phenotype was higher in patients with DRF while sarcopenia rates were similar in both groups. Nonrobust phenotype was an independent risk factor predicting DRF. The present study demonstrated that screening of older people for frailty and detecting nonrobust phenotype is a predictor for DRF. Appropriate management of these patients may reduce the fracture risk.

Declaration of Conflicting Interests

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