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Sarcopenia and Risk of Falls in Patients with Chronic Kidney Disease, a Meet of Three Geriatric Giants

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Abstract

Background: Sarcopenia is devastating health problem in geriatric population in general and in patients with chronic kidney disease in particular.

Aim: to assess the risk of falls in chronic kidney disease patients with sarcopenia.

Methods: : A case control study was conducted, including 80 male and female elderly population aged 60 years old and above, at different stages of CKD including patients on hemodialysis, who were admitted to Ain Shams University Hospitals. They were divided into 41 cases and 39 controls according to the presence or absence of sarcopenia. History was taken, calf circumference was measured and blood sample was withdrawn for measuring creatinine level, parathyroid hormone and hemoglobin level. Risk of falls was assessed using gait speed and timed up and go test.

Results*:* participants with sarcopenia had higher risk of falls, lower muscle mass, hand grip strength, gait speed and calf circumference. Calf circumference was associated with low gait speed, greater time in timed up and go test in chronic kidney disease participants with sarcopenia. Anemia was associated with low gait speed and hyperparathyroidism with higher score in timed up and go test.

Conclusions: chronic kidney disease patients with sarcopenia have higher risk of falls. Calf circumference, anemia, and hyperparathyroidism are associated with higher risk of falls in these patients.

Keywords: sarcopenia- falls- chronic kidney disease- elderly

Background

Sarcopenia is a common geriatric health problem which is anticipated to row with age. The term Sarcopenia (Greek, sarx for "flesh" and penia for "loss") refers to reduction of both muscular mass and function with aging (1).

The prevalence varies widely all over the world. The prevalence of sarcopenia among nursing home older residents in Cairo was 17.7%, more in elderly men; about 22.2% and 14.4% in elderly women, increasing morbidity, dependency and hospitalization (2).

Many scientists consider sarcopenia to be an inevitable part of aging. However, the degree of sarcopenia is highly variable and is dependent upon the presence of certain risk factors like lack of exercise, malnutrition, hormonal and cytokines imbalance (3).

Although sarcopenia was related to aging process, researchers currently recognize the important role of catabolic diseases, such as chronic kidney disease (CKD), in the etiology of sarcopenia (4).

CKD increased in elderly population and some consider it as a new geriatric giant.In fact, metabolic derangements associated with CKD lead to increased protein catabolism, resulting in diminished muscle mass and function, independent of age. Therefore, it can be hypothesized that CKD patients are more prone to develop sarcopenia (5).

Fall in elderly population is one of the major geriatric giants. It is estimated that approximately one third of the general population above the age of 65 years suffers from at least one fall every year whereas half of those elderly people falls repeatedly (6).

Falls predict hospitalization, functional decline, and the need for long-term institutional care and lead to increased mortality. Even in the absence of physical

injury, falls can lead to fear of falling, decrease mobility and dependency (7). There is evidence that sarcopenia is associated with accidental falls. In a meta- analysis and systematic review of the health outcomes related to sarcopenia it was shown that sarcopenic subjects were at a higher risk of accidental falls, fractures, hospitalization and longer hospital stay compared with robust subjects (8)

Patients with CKD, and especially those on hemodialysis are on greater risk of falling and fall-related complications (9).

Recently researchers started to study the prevalence and risk factors of sarcopenia in CKD and dialysis patients and few addressed the incidence and the risk of falls in dialysis patients, but to our knowledge no researches were done in Egypt to study the risk of falls in elderly patients with sarcopenia or even predictors of such important geriatric giants in patients suffering from CKD or on hemodialysis.

Methods

A case control study included eighty male and female elderly populations aged 60 years old and above, at different stages of CKD including patients on hemodialysis, recruited from Ain Shams University Hospitals during the period between October 2017 and April 2018. They were divided into 2 groups according to the presence or absence of sarcopenia as follows:

Cases: 41 subjects with sarcopenia

Controls: 39 subjects without sarcopenia

Diagnosis of sarcopenia was done according to the European Working Group on Sarcopenia in Older People (EWGSOP) if the participant had low muscle mass, and either decreased strength or performance (10).

Exclusion criteria

Patients with dementia, delirium, critical illness, receiving drugs causing muscle weakness, history of cerebrovascular accidents, end organ failure were excluded from the study.

All individuals were subjected to the following after accepting to participate in the study:

1-History taking (including personal, medical and drug history)

2- Functional assessment using activities of daily living (ADL) (11) and Instrumental activities of daily living (IADL) (12).

ADL: The subject was asked about bathing, dressing, toileting, transfer, continence and feeding. Subjects were classified as independent, assisted or dependent.

IADL: The subject was asked about the ability to use telephone, shopping, food preparation, housekeeping, laundry, mode of transportation, responsibility of own medication, and the ability to handle finance. Subjects were classified as independent, assisted or dependent.

3-Assessment for fall risk by using:

A-Timed up and go test (13).

Test began with the subject sitting in a chair with arm rests. The subject was allowed to use the arm rests during sitting, not on standing. Test started by the subject standing up, walk for 3 meters, turn around and walk back to the chair and sit down. The subject walked at his regular pace, used his regular footwear, might use any gait aid that they normally use during ambulation, but might not be assisted by another person.

A score of more than or equal to 14 indicates high risk of fall.

B- Gait speed (14).

Gait speed is a valid, reliable, sensitive measure appropriate for assessing and monitoring functional status and overall health and measuring risk of falls in a wide range of populations. These capabilities have led to its designation as the “6th vital sign” (15).

Participants were instructed to walk over a 10-meter (m) straight course at their usual speed. Usual gait speed was derived from the middle 4 m (from the 4-m line to the 8-m line), divided by the time spent in seconds. Cut-off values were 0.8 m/s or less for the 4 meters walk.

4- Measurement of Calf circumference (CC)

CC is one of the anthropometric measures used in assessment of nutritional status. CC was measured on the right calf, while the subject was sitting. The measuring tape was placed around the calf and moved up and down to locate the maximum circumference in a plane perpendicular to the long axis of the calf. The calf circumference was recorded to the nearest 0.1 cm (16).

5- Diagnosis of sarcopenia

A-Measurement of muscle mass: bioelectrical Impedance Analysis (BIA) was performed using beurer Glass diagnostic scale (BG42, Germany).

Absolute muscle mass was measured in the study and total skeletal muscle mass index (TSMMI) was calculated. TSMMI = absolute muscle mass/ height in m^2. The cut off points using TSMMI for diagnosis of sarcopenia were 8.51- 10.75kg/m2 for moderate and < 8.5Kg/m2 for severe sarcopenia in men and 5.76-6.75kg/m2 for moderate and <5.75kg/m2 for severe sarcopenia in women (17).

B- Measurement of Muscle Strength: A handheld dynamometer (Jamar Hydraulic hand dynamometer; 5030J1, USA) was used to assess hand grip strength (HGS)

Participants were instructed to keep their arms by the sides of their body. The participant squeezed the dynamometer with the dominant hand using maximum isometric effort. No other body movement was allowed and the better performance of the 2 trials was used. Low muscle strength was defined as HGS less than 30 kg in men and 20 kg in women (15).

C-Physical performance: was assessed by usual gait speed.

6- Measurement of serum creatinine, hemoglobin level, and parathyroid hormone and correlation with gait speed in patients with sarcopenia.

Table (1): Demographic and clinical data in sarcopenic and non sarcopenic groups

		Controls		Cases	P-value
		not sarcopenic (N 39)		Sarcopenic (N 41)	
		Mean / N	SD / %	Mean / N SD / %	
Age		63.69 ± 4.07		64.88 ± 4.47	0.22(T)
sex	Male	16 (41.0%)		19 (46.3%)	0.632(C)
	Female	23 (59.0%)		22 (53.7%)	
education	Literate	3 (7.7%)		7 (17.1%)	0.313(F)
	Illiterate	36 (92.3%)		34 (82.9%)	
smoking	Current	8 (20.5%)		9 (22.0%)	0.916(F)
	Ex-smoker	5 (12.8%)		4 (9.8%)	
	Passive	7 (17.9%)		10 (24.4%)	
	Not smoker	19 (48.7%)		18 (43.9%)	
ADL	independent	31 (79.5%)		16 (39.0%)	0.001
	assisted	4 (10.3%)		16 (39.0%)	
	dependent	4 (10.3%)		9 (22.0%)	
IADL	independent	21 (53.8%)		10 (24.4%)	0.015
	assisted	11 (28.2%)		14 (34.1%)	
	dependent	7 (17.9%)		17 (41.5%)	
TUGT	No risk of fall	25 (64.1%)		4 (9.8%)	<0.001(F)
	Risk of fall	13 (33.3%)		36 (87.8%)	

Statistical analysis: Analysis of data was performed by using the Statistical Package for Social Science (SPSS16). Description of all data in the form of mean (M) and standard deviation (SD) for all quantitative variables was done.

Frequency and percentage was done for all qualitative variables. Comparison between quantitative variables was done using t-test to compare two groups and ANOVA (analysis of variance) to compare more than two groups. Post Hoc test was done to detect the least significant difference.

Comparison of qualitative variables was done using the Chi-square test. Correlation coefficient was used to find linear relation between different variables using r-test or Sperman correlation co-efficient. Significant level was measured according to P value (probability), P>0.05 is insignificant, P<0.05 is significant and p<0.01 is highly significant.

Results

The mean age of the study population was 63-64 as shown in Table 1. There is no significant difference between cases and controls regarding age, sex, education or smoking history. Cases has worse function

in ADL and IADL (p 0.001, 0.015) respectively and higher risk of falls p< 0.001. In Table 2 all parameters diagnosing sarcopenia were much lower in cases with highly significant difference (p < 0.001) for all. CC was also lower (p< 0.001). Gait speed did not correlate with either muscle mass measured using BIA or hand grip (p 0.162, 0.092) respectively as shown in Table 3.

TUGT was not related also to muscle mass or hand grip strength (p0.520, 0.807) respectively. CC correlated with both gait speed and TUGT (p 0.045, 0.020) respectively.

There was also a positive correlation between hemoglobin level and gait speed, parathyroid hormone level and TUGT (p 0.01, 0.045) respectively. There was highly significant inverse correlation between gait and TUGT (p 0.0009).

Table (2): Clinical assessment in cases and controls

	Controls (N 39)		Cases (N 41)		
	Mean	SD	Mean	SD	P-value
Gait speed	0.61	0.27	0.31	0.20	<0.001(T)
Hand grip	23.1	4.7	17.9	4.6	<0.001(T)
Calf circumference	34.28	6.12	28.46	2.83	<0.001(T)
BIA	9.50	1.60	7.78	2.33	<0.001(T)

BIA= bioelectrical impedance

Table (3): Correlation between TUGT, gait speed and clinical and laboratory data

	Gait speed		TUGT	
	r	P value	r	P value
BIA	**0.222**	**0.162**	**-0.103**	**0.520**
Hand grip	0.266	0.092	-0.039	0.807
CC	**0.314**	**0.045**	**-0.359**	**0.020**
Creatinine	-0.096	0.549	0.254	0.109
Hb level	**0.395**	**0.010**	**-0.061**	**0.702**
Parathyroid hormone	-0.182	0.252	0.314	0.045
TUGT	**-0.499**	**0.0009**	----	

Discussion

Sarcopenia is a rising problem in elderly patients suffering from CKD. Age, sex, education and smoking did not differ between sarcopenic and robust participants. Sarcopenic participants with CKD whether on conservative therapy or on dialysis had decline in function affecting both activities of daily living and instrumental activities of daily living. These patients also had significant reduction in muscle mass, strength and higher risk of falls which made them more vulnerable to loss of independency and physical inactivity as found by others (18). Souza and colleagues (19) also demonstrated that CKD patients with sarcopenia had worse physical performance and high risk of falls, which was reflected by low walking speed, worse performance in ADLs, less functional capacity, and a higher prevalence of physical inactivity compared with patients without sarcopenia.

No association was found between either gait speed or TUGT and hand grip muscle strength, and muscle mass. Muscle mass may not predict strength or performance especially in CKD; whereas it may be affected by body hydration. Due to the feasibilty, reliability, and low cost of hand grip dynamometry in measuring muscle strength, it was identified as initial screening method for sarcopenia in clinical settings (10, 14). However, researchers have also found that lower extremity strength may serve as a more reliable assessment measure for sarcopenia, since it is significantly associated with gait speed and more predictable of muscle performance and risk of falls. This may be explained by the minimal role of the finger and wrist flexors in gross mobility tasks, and hence lower extremity strength may be better associated with functional activities in comparison to hand grip strength (20, 21).

CC was associated with high risk of falls when measured by both gait speed and TUGT. It was found that low calf circumference increases falls risk in naval veterans (22).

TUGT increased with higher values of parathyroid hormone. Some researchers observed that higher PTH levels are related to higher risk of falls and decreased muscle performance (23) considering that increased bone fragility, muscle weakness associated with hyperparathyroidism are independent risk factors for the occurrence of falls and fractures. Therefore, high PTH levels associated with low vitamin D levels in individuals with CKD and especially those on hemodialysis cause a negative impact on muscle strength and functional mobility, because they cause atrophy of muscle fibers of rapid concentration, thus predisposing the individuals to falling (24).

Anemia was associated with lower gait speed. There is conflicting results regarding the association between anemia and risk of falls. There are studies that relate falls to anemia and others that do not come to this conclusion (25, 26).

Conclusion:

CKD patients with sarcopenia have higher risk of falls. Calf circumference, anemia, and hyperparathyroidism are associated with higher risk of falls in those patients. No association was found between muscle mass or hand grip strength and risk of falls. Gait speed and TUGT have strong inverse correlation with each other. To our knowledge this the first study in Egypt to detect risk of falls in CKD patients diagnosed to have sarcopenia. More studies with larger population are needed to

detect the prevalence of falls and detect all risk factors in such important category of population.

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Conflict of Interests

The author has no conflict of interests to declare regarding the publication of this paper.

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