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MALNUTRITION AND MALNUTRITION RISK CAN BE ASSOCIATED WITH SYSTOLIC ORTHOSTATIC HYPOTENSION IN OLDER ADULTS

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Abstract: *Background:* Malnutrition and orthostatic hypotension(OH) are the two important geriatric syndromes, which have similar negative outcomes such as falls. The aim of the study is to detect whether there is any relation between malnutrition and OH. *Methods:* 862 geriatric patients, who had undergone comprehensive geriatric assessment (CGA),were included in the retrospective study. OH was identified as 20 and/or 10 mmHg dropped for systolic and/or diastolic blood pressures with the active standing test when patients got up from supine to standing position. Nutritional status was checked according to Mini Nutritional Assesment-Short Form(MNA-SF). *Results:* The mean age of the patients was 74±8.05, and %66.3 of them were female. The prevalence of malnutrition, malnutrition-risk and OH were detected as 7.7%, 26.9 % and 21.2%, respectively. When OH, systolic OH, diastolic OH and control group were compared with CGA parameters and the effects of age and gender were removed, the frequency of falls and Timed-Up and Go Test were higher, activity daily living indexes and TINETTI-Balance scores were lower in systolic OH than without it ($p<0.05$).Systolic OH was more frequent in malnutrition-risk and malnutrition group than control group ($p<0.002$ and $p<0.05$, respectively). Diastolic OH was not associated with nutritional status ($p>0.05$).OH was only higher in malnutrition-risk group than robust ($p<0.05$). *Conclusion:* Our findings suggest that not only malnutrition but also malnutrition-risk may be associated with systolic OH, which leads to many negative outcomes in older adults. Because malnutrition/ malnutrition risk is preventable and reversible, nutritional status should be checked during the evaluation of OH patients.

Key words: Malnutrition, malnutrition-risk, orthostatic hypotension.

Introduction

Malnutrition, which is frequently seen in older adults, causes negative serious outcomes. Prevalence of malnutrition is 5-10% in community-dwelling older adults, 30-61% in hospitalized older patients and 12-85% in nursing homes (1). Malnutrition, increases the risk of infection, sarcopenia, frailty, pressure injury, falls, fracture and mortality, causing a delay in immune response and wound healing (2). In other words, the risk of malnutrition is a major health problem and should not be missed in older adults (3). In a study, impaired mental health was strongly associated with malnutrition-risk in community-dwelling older adults (4). It is demonstrated that malnutrition-risk is an independent predictor of mortality, length of stay and health care costs (5). In community-dwelling young-old (65-74 years) people, depression was strongly associated with malnutrition-risk (6). Despite all those negative effects, malnutrition, a disorder that can often be overlooked, remains a significant and frequent public health problem (7). Therefore, regular nutritional status screening should be recommended in older adults (8)

Orthostatic hypotension(OH), which is another geriatric syndrome, is also related to cardiovascular events, recurrent falls, impaired sleep quality, depression, stroke, syncope and consequent injuries (9-11). Even if its prevalence differs in studies, the ratio varies up to 70% for Parkinson's patients while it is generally 30% in community-dwelling older adults over >65 years (12). Except for a few rare neurological diseases leading to autonomic deficiency, many avoidable causes might be associated with OH in older patients with dehydration, polypharmacy, comorbid diseases, vitamin B12 and vitamin D deficiency (13, 14). However, previous studies have clearly shown that OH association with micronutrients deficiency, the relationship between OH and malnutrition and/or the risk of malnutrition is unknown. On the other hand, although it is known that systolic OH and diastolic OH have different etiopathogenesis and cause different clinical outcomes(15), their effects on nutrition are unknown.

Since these two important geriatric syndromes may result in similar outcomes, OH may be associated with malnutrition and malnutrition-risk. The aim of this study is to reveal the relationship between nutritional status and OH (systolic and diastolic) in older adults.

Material and method

Patients' Characteristics

3162 patients, who had visited our outpatient clinic and undergone comprehensive geriatric assessment from January 2014 to December 2016, were evaluated retrospectively. Demographic characteristics, blood pressure, comorbid diseases, polypharmacy, cognitive and nutritional status, basic and instrumental daily living activity indexes (BADL and IADL) and laboratory measurements were obtained from hospital files.

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Exclusion criteria

Patients with the following conditions were excluded; anemia (hemoglobin <11 g/dL), neurological diseases that may lead to OH such as multiple system atrophy, Parkinson's disease, spinal cord injury; acute renal injury or chronic renal disease, inflammatory bowel disease, adrenal-pituitary insufficiency and untreated thyroid disease; cardiovascular diseases such as serious aortic stenosis or carotid artery stenosis, arrhythmia; frequent alcohol use; dehydration, electrolyte imbalance, acute hemorrhage, sepsis, malignancy, paraneoplastic syndrome and similar serious comorbid diseases. Additionally, patients who couldn't stand up actively by themselves or who were immobile were not included in the study. There was no patient with a premorbid diagnosis of OH attending the clinic, and no patients had been taking any nutritional supplements. The patients who had missing data in the hospital records for the study were also excluded. As a result, 862 patients were available for study analysis.

Comprehensive Geriatric Assessment (CGA)

Age, sex, education, number of medicine used, body height, body weight, body mass index (BMI), comorbidities (hypertension, diabetes mellitus, coronary artery disease, congestive heart failure, peripheral arterial disease, chronic obstructive pulmonary disease, hyperlipidemia, cerebrovascular disease, depression) were recorded. Whether the patients had fallen the year before was recorded. Cognitive functions were evaluated with Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MOCA) and Cognitive State Test (COST) according to the educational level. In addition, Yesevage Depression Scale (YDS), BADL and IADL were analyzed for each patient. Tinetti Performance Oriented Mobility Assessment was examined retrospectively (16). Mobility was evaluated with the timed up and go test (TUG). Nutritional status was determined by Mini-Nutritional Assessment-Short Form (MNA-SF). The patients were divided into three groups according to their MNA-SF scores: malnourished (0–7 points), malnutrition-risk («at-risk», 8–11 points), or well-nourished (12–14 points). The Body Mass Index (BMI) of the patients was calculated by using the body weight (kg) and the body height (cm).

Blood pressure measurements

The first blood pressure (BP) measurement was taken following 10 min of rest at the supine position; afterward, the patients were raised upright and the measurement repeated on the same arm at the 1st and 3rd minutes, using a Mercury sphygmomanometer with an appropriately sized cuff.

Orthostatic Hypotension

The diagnosis of OH was made in the event of 20 mmHg, with a higher decrease in systolic pressure and/or 10 mmHg and a higher decrease in diastolic pressure during the transition from supine to standing up position with the active standing test on the third minute (17). Systolic and diastolic OH were defined as a decrease in postural systolic blood pressure and in postural diastolic blood pressure, respectively.

Laboratory Findings

Fasting blood glucose, kidney and liver function tests, lipid profile status, thyroid stimulating hormone (TSH) levels, Vitamin B12, Folic acid and Vitamin D levels ,which were routinely tested, were analyzed.

Statistical Analysis

Continuous variables were calculated with average ± standard deviation. Kolmogorov-Smirnov test was given to observe whether continuous variables are appropriate to the normal distribution or not. 'Independent Sample t-test' was used for the parameters suitable for the normal distribution ,while 'Mann-Whitney U test' was used for the parameters unsuitable for the normal distribution. Rate variations were analyzed by 'Chi-Square' test. The value p<0,05 was regarded as statistically significant. SPSS 22.0 (SPSS Inc.) package program was used for the whole statistical analysis.

Ethical Committee

The investigation was suitable to the Declaration of Helsinki and approved by the local ethics committee. The required number of samples was calculated to be at least 390 patients with an acceptable error of 5% and a 95% confidence level (18).

Results

Total 862 patients of mean age was 74±8.05 and 65.3% were female. While the risk of malnutrition was 7.7%, malnutrition-risk was 26.9% and OH was determined as 21.2%. Although female gender was statistically higher in both systolic and diastolic OH group (p<0.05), age was merely higher in systolic OH group (p<0.05). In the presence of OH, dementia, diabetes mellitus, and ischemic heart disease were observed more frequently. (p<0.05). Falls were more common in systolic OH group (p<0.05). While MOCA, IADL, TINETTI-Gait performance scores were lower in OH; TUG was longer in OH group compared to control group (p<0.05). Patients' characteristics were summarized in Table 1. When the age and gender effects between the groups were removed, only the systolic OH remained significant with the frequency of falls, IADL, TUG, TINETTI-balance.

In the context of the relationship between nutritional status and TINETTI-Gait, TINETTI-Balance and TINETTI-Total scores were lower, whereas TUG duration and the rates of falls were higher in malnutrition and malnutrition-risk group than control group (p<0.05). However, these rates of falls and TINETTI-Gait scores were not statistically different between the malnutrition and malnutrition-risk group (p>0.05).

The relationship between nutritional status and postural

Table 1
Patient Characteristics according to presence of Systolic OH, Diastolic OH and OH

	OH (-) (n:598)	OH (+)			p1 value	p2 value	p3 value
		Systolic OH (n:169)	Diastolic OH (n:188)	Orthostatic OH (n:264)			
Age	73.83±8.44	75.21±7.14	74.48±6.95	74.39±7.07	0.038	0.435	0.454
Gender (female %)	68.7	55.6	58.8	57.4	0.003	0.036	0.001
Year of study	7.67±4.58	7.78±4.40	7.57±4.58	7.69±4.58	0.752	0.738	0.965
BMI(kg/m2)	28.49±5.13	28.26±5.78	28.63±5.52	28.62±5.52	0.319	0.969	0.922
COMORBIDITIES (%)							
Falls	28.8	40.2	36.2	36	0.004	0.086	0.037
Dementia	17.7	31.5	26.9	27.3	0.001	0.067	0.008
Cerebrovascular Disease	6.7	10.1	6.9	8	0.094	0.914	0.512
Depression	32.3	36.9	34.2	34.2	0.233	0.693	0.620
Hypertension	63.5	69.2	69.7	69.3	0.228	0.151	0.097
DM	24.9	36.7	36.2	35.2	0.006	0.005	0.002
Hyperlipidemia	18.9	20.7	18.6	19.7	0.569	0.829	0.792
Coronary Artery Disease	13.4	24.6	22.9	20.5	0.115	0.002	0.009
Congestive Heart Failure	6.2	6.5	9	7.6	0.945	0.132	0.457
COLD	8.5	7.1	7.4	8.3	0.540	0.551	0.897
Hypothyroidism	21.1	15.4	18.1	17.8	0.088	0.437	0.265
Osteoporosis	22.6	19	20.9	20.2	0.317	0.693	0.408
LABORATORY FINDINGS							
Albumin (g/L)	4.13±0.38	4.07±0.49	4.07±0.49	4.08±0.45	0.351	0.400	0.400
LDL cholesterol (mg/dL)	134.25±39.32	128.41±41.6	129.16±40.87	129.85±40.6	0.064	0.185	0.147
Sodium (mmol/L)	139.38±2.74	139.01±3.12	138.46±7.86	138.71±6.85	0.254	0.215	0.341
TSH(mg/dL)	2.16±6.29	1.56±1.19	4.26±31.56	3.52±26.65	0.135	0.370	0.355
Vitamin B12(pg/mL)	454.47±343.15	516.89±443.96	461.54±357.94	482.88±395.34	0.951	0.987	0.969
25(OH)D (ng/mL)	20.06±11.95	21.29±17.34	20.47±14.42	20.35±15.17	0.522	0.726	0.260
GERIATRIC ASSESSMENT							
MMSE	24.16±6.02	22.92±6.36	23.53±6.35	23.68±6.02	0.043	0.302	0.263
COST	23.26±4.99	21.59±6.57	21.94±6.45	22.28±6.35	0.305	0.323	0.596
MOCA	23.70±4.52	20.37±6.31	21.58±5.57	21.54±5.96	0.001	0.036	0.016
Basic ADLs	91.37±12.76	88.40±15.85	90.48±13.97	90.29±14.35	0.028	0.811	0.617
IADL	17.72±6.29	15.33±7.16	16.50±6.72	16.42±6.66	<0.001	0.027	0.002
Tinetti-Gait	10.41±2.24	9.97±2.40	10.28±2.03	10.16±2.21	0.008	0.149	0.02
Tinetti-Balance	13.68±3.04	13.21±3.55	13.74±2.94	13.60±3.19	0.099	0.996	0.777
POMA	24.09±5.09	23.17±5.75	24.02±4.70	23.75±5.16	0.038	0.425	0.193
Up&Go Test	14.23±9.11	16.48±10.90	14.90±9.41	15.07±9.24	0.001	0.106	0.02

p1 value: comparison for between Systolic OH group and control group; p2 value: comparison for between Diastolic OH group and control group; p3 value: comparison for between OH group and control group; BMI: Body Mass Index; DM: Diabetes Mellitus; COPD: Chronic Obstructive Pulmonary disease; LDL: Low Density Lipoprotein; TSH: Thyroid Stimulating Hormone; 25(OH) D: 25Hydroxy Vitamin D; MMSE: Mini–Mental State Examination (0 [the worst]-30 [the best]); COST: Cognitive State Test (0 [the worst]-30 [the best]); MOCA: Montreal Cognitive Assessment (0 [the worst]-30 [the best]) Basic ADLs: Basic Activities of Daily Living (0 [the worst]-100 [the best]), IADL: Instrumental Activities of Daily Living (0 [the worst]-17 [the best]); POMA: Performance-Oriented Mobility Assessment (0 [the worst]-28 [the best]);

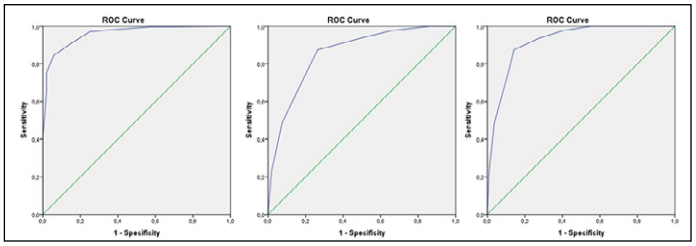
Table 2
The relationship between nutritional status and gait-balance functions and orthostatic blood pressure changes

	Malnutrition Group, MNA<7 (n:67)	Malnutrition-Risk Group, MNA 8-11 (n:232)	Normal Nutrition Group, MNA>12 (n:563)	P value	p1 value	p2 value	p3 value
GERIATRIC ASSESSMENT							
Falls %	44.8	36.5	27,2	0.001	0.004	0.009	0.221
Tinetti-Gait	9.06±2.68	9.51±2.74	10.82±1.74	<0.0001	<0.0001	<0.0001	0.111
Tinetti-Balance	11.03±3.88	12.64±3.76	14.38±2.30	<0.0001	<0.0001	<0.0001	<0.0001
Tinetti-Total	20.09±6.29	22.15±6.28	25.20±3.82	<0.0001	<0.0001	<0.0001	0.004
Up&Go Test	21.21±12.90	17.10±11.47	12.68±6.66	<0.0001	<0.0001	<0.0001	0.007
ORTHOSTATIC HYPOTENSION							
Systolic OH (%)	25,4	26,3	16,2	0.002	0.048	0.001	0.880
Diastolic OH (%)	22,4	25,4	20,2	0.272	0.682	0.107	0.611
OH (%)	32,8	36,2	28,1	0.071	0.414	0.027	0.611

P value: between three groups; p1 value: between normal and malnutrition group; p2 value: between normal and malnutrition risk group; p3 value: between malnutrition and malnutrition risk group

blood pressure changes is shown in Figure 1. The rates of OH were higher in malnutrition-risk group than robust group ($p<0.03$). They were not statistically different between malnutrition and malnutrition-risk or robust group ($p>0.05$). Systolic OH was more frequent in malnutrition-risk and malnutrition group than control group ($p<0.002$ and $p<0.05$, respectively). However, systolic OH rates were similar between malnutrition and malnutrition-risk group ($p>0.05$). There was no relationship between diastolic OH and nutritional status ($p>0.05$).

Figure 1
Frequency of Orthostatic Hypotension According to Nutritional Status



Discussion

In this cross-sectional study, 862 older patients were retrospectively evaluated and it was found that both malnutrition and malnutrition-risk might be related to systolic OH in older adults. It is also found that malnutrition-risk may be predictive for OH.

Malnutrition is a devastating health condition in elderly. Among older adults in the US, malnutrition affects an estimated 3 million individuals and is associated with functional decline, decreased quality of life, and mortality (19). As malnutrition brings an important economic burden around the world, the total economic burden of disease-associated malnutrition in the US is approximately $157 billion annually (20). Therefore, it is important to screen nutritional status in the geriatric population and determine the frequency of malnutrition. In this study, the frequency of malnutrition and malnutrition-risk was 7.8% and 26.9%, respectively. Schrader et al. observed that malnutrition rate was 8.9% and malnutrition-risk rate is 36.3% by using MNA-SF (21). As malnutrition and malnutrition-risk rates for community-dwelling older people are reported between 10% and 40% (18, 19), the rates from our study are compatible with the literature.

On the other hand, OH affects morbidity and mortality in older adults. Since the frequency of OH also increases with age, it was found as 30.6% in our study. Although the studies about the prevalence of orthostatic hypotension show heterogeneity, the prevalence is around 30% for the community-dwelling older adults over age 65 years (22). Therefore, our findings are compatible with the literature.

The interaction between OH and certain risk factors such as hypertension, coronary artery disease, diabetes mellitus, congestive heart failure, peripheral vascular disease, hyperlipidemia, polypharmacy, vitamin D or B12 deficiency and gender is controversial in the literature (23, 24). Due to the fact that malnutrition and OH lead to similar negative outcomes such as falls, balance disorders, cognitive impairment, etc., it is considered that the two might be related to each other, which has not been mentioned beforehand (25, 26). It was

demonstrated that both malnutrition and malnutrition-risk were associated with systolic, but not diastolic OH in the present study, which could be explained by several hypotheses. First, the mechanism that may explain the relationship between malnutrition and systolic OH may be the autonomic dysfunction. According to a meta-analysis describing the causes of aging, anorexia was reported to be involved in the etiopathogenesis of autonomic dysfunction (27). Autonomic neuropathy also may play a role in the etiology of OH (28), as systolic OH may be associated with sympathetic failure (29). Second, it is known that systolic OH is caused by impaired peripheral vasoconstriction (29). Sarcopenia is a geriatric syndrome leading to loss of muscle mass. Working groups consensus proposed to define sarcopenia as a syndrome characterized by age-related loss of muscle mass and loss of muscle function, including muscle mass and strength and/or physical performance (30). In a study, parameters of malnutrition were shown to be related with diagnostic measures of sarcopenia in geriatric outpatients and the association between parameters of malnutrition and diagnostic measures of sarcopenia was significant for both relative and absolute muscle mass (31). Influence of nutritional-related reduction in muscle mass and muscle tone in vascular muscle mass may also signify the association.

According to literature, Luukkonen A et al. reported in a similar study that the all patients with OH lower MNA scores, which is not related to malnutrition and malnutrition-risk (32). However, in their study, the other nutritional factors such as the vitamins D and B12, which are well-known to cause OH are not elaborated in detail (14-23). In this study, we excluded all the factors affecting OH and nutritional status, since the comorbidities and laboratory parameters were detailed. Therefore, the present study is one of the rare studies that evaluate clearly the effects of malnutrition on elderly patients with OH.

This study has many strengths. First, malnutrition and malnutrition-risk groups were assessed separately. Second, the sample size was large. Third, many factors that might cause OH were evaluated simultaneously. Fourth, systolic and diastolic OH were evaluated separately. The research has some limitations. The most important one is that it is a cross-sectional and retrospective study. The another limitations are that MNA-long form was not used and that the diagnosis of OH was measured with active stand test instead of head-up-tilt table test (33). The last, the number of patients with malnutrition was lower than others; thus, OH might not be related with malnutrition, but malnutrition risk.

As a result, both malnutrition and malnutrition-risk might correlate with systolic OH in older adults, regardless of micronutrient deficiency. Therefore, the risk of malnutrition is at least as important as malnutrition. For that reason, community-dwelling older adults should be screened with regard to both nutritional status and alterations in orthostatic blood pressure and necessary measures should be taken as soon as the malnutrition-risk is detected.

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