

Hospitalization Effects on Physical Performance and Muscle Strength in Hospitalized Elderly Subjects

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Abstract

Background: Hospitalization is a stressful event, potentially dangerous for older people. In fact, it worsens and accelerates muscle mass loss associated with bed rest, increasing the risk of loss of autonomy, rehospitalization and mortality.

The aim of this study was to evaluate in an acute care setting handgrip and physical performance in patients at hospital admission and discharge, and detect changes related to hospitalization.

Methods: Between June 2011 and January 2012 we were recruited 355 patients of which about 255 it was possible to perform at least Handgrip both at admission and at discharge. Of these, 38.8% were female.

Handgrip strength and physical performance by using the short physical performance battery (SPPB) were assessed at admission and before the discharge. In all subjects Barthel index and mini nutritional assessment (MNA) were also evaluated.

Results: A significant worsening in walking speed, chair stands test and handgrip strength performance was observed. On the contrary the study population showed an improvement in the Barthel index. No significant differences between males and females in performance and muscle strength loss were observed. The chair stand test performance worsens further in malnourished patients.

Conclusion: our data suggests that during hospitalization elderly patients experience a loss of performance and muscle strength, with no differences between males and females. Subjects with score indicative of malnutrition or at risk for malnutrition presented a chair stand test performance worsening significantly greater than subjects with normal nutritional status.

Keywords: Sarcopenia; Walking speed; Handgrip; Inflammation; Malnutrition

Introduction

Older persons are at high risk of loss of autonomy. Hospitalization and acute medical events represent stressful events for older persons, leading to functional decline, worsening disability, nursing home admission and mortality in older patients [1-3]. The Hospital Outcomes Projects for the Elderly estimated that in hospitalized old patients, 19% had a decline in activity of daily living (ADL) and 40% had instrumental activity of daily living (IADL) decline in the 3 months after hospital discharge, compared with their disability status before hospital admission [4].

Identification of patients at higher risk for functional decline during hospitalization is important in order to prevent the development of adverse outcomes, but traditional clinical assessment has shown limited capacity to discriminate people at high risk [5].

Hospitalization is associated with the decline in function and muscle performance. Mechanisms involved are not yet fully known [6].

Inflammation, associated with different acute and chronic pathological conditions, has been proposed as a key factor inducing muscle wasting leading to physical function and strength decline. Growing evidence suggested a direct role of circulating pro-inflammatory cytokines in the deterioration of physical performance with a direct effect on the imbalance between protein anabolism and catabolism [7-9].

Measurements of physical performance may prove an additional and useful clinical tool for health-related risk stratification. A large body of evidence demonstrate the predictive value of different mobility performance tests in terms of various adverse outcomes [10-12]. The short physical performance battery (SPPB) has been tested in different settings as predictor of disability, hospitalization, institutionalization, and mortality [13,14].

Furthermore, even nutritional problems are shown to be that related to impaired functional ability [15].

The aim of this study was to examine changes in physical performance and handgrip strength during hospitalization as well as evaluate their interrelationship with nutritional status

Method

Study design

Between January and August 2011 a total of 353 patients were recruited in the geriatrics acute care of Verona. Patients were eligible for inclusion if they were aged 65 years or older, were admitted on a weekday and consented to participate in the study within 24 hours of admission and if they were without mild to severe cognitive impairment, precluding appropriate informed consent as described elsewhere [16]. 48 patients were not included because they denied consent to participate or because of serious medical conditions. In 50 subjects was not possible to perform SPPB tests at both admission and discharge for worsening clinical conditions during hospitalization. Analysis was performed in a final sample of 255 patients with complete handgrip test data as assessed at admission and discharge. In a subsample of 169 subjects was possible to assess also the entire SPPB test battery at the beginning and at the end of hospitalization.

Anthropometric measures

Height and weight of patients were evaluated at the beginning of hospitalization as previously reported [14]. Body mass index (BMI) was calculated as the ratio between weight and height squared (kg/m^2).

Physical performance, strength test and disability evaluation

The SPPB was administered at the time of hospitalization and before discharge and consisted of three tests: gait speed over 4 meters, balance and five-chair stands test [11].

Muscle strength was assessed by handgrip dynamometer (Jamar Handheld Dynamometer, Sammons Preston Rolyan, IL, United States) using a standardized protocol [17]. The best of three trials with dominant hand was used for the present analysis. The cut-off used to evaluate strength reduction was <30 kg for men and <20 kg for women [17]. The degree of disability was evaluated with ADL, IADL and Barthel Index as described elsewhere [16,18].

Evaluation of nutritional status

At the beginning of hospitalization, nutritional status was assessed using the original version of the mini-nutritional assessment (MNA) as described elsewhere [16,19].

Statistical analysis

Results are shown as means \pm SD. Preliminarily the Kolmogorov-Smirnov test was performed on all the variables (separately in males and in females) to assess for evidence of non-normality in the data. Log transformations were performed for non-normal variables.

Comparisons of performance variables and handgrip strength at the hospital admission and discharge were made by using paired t-test.

Chi-square tests were performed for categorical variables. Student's t-test and the chi-square test for categorical variables were used to compare variables between subjects who were able to perform gait speed and those unable to do so.

Analysis of variance (ANOVA) was also performed to compare the changes in study variables between sexes, Barthel changes classes (categorized as stable or improved vs worsened) and MNA classes (malnourished and at risk for malnutrition vs normal).

Percentage of subjects with performance test and handgrip worsening was calculated. A significance level of 0.05 was used throughout the study. Statistical analyses were performed using SPSS 20.0 (SPSS Inc, Chicago, Ill).

Results

The clinical characteristics of the study population (mean \pm SD) are presented in Table 1. The study population consisted of a total of 255 subjects of both sexes (38.8% female) with a mean age of 81.0 ± 7.3 and BMI of 25.5 ± 16.5 kg/m^2 . 27.8% of patients were hospitalized for heart failure, 11% for syncope, 6.2% for angina or acute coronary syndrome, 5.9% for onset of atrial fibrillation, 4.7% for pneumonia or bronchopneumonia, 4.7% for fever, 3.5% for acute anemia, 2.7% for cancer, 2.7% for urinary tract infection, 2.3% for exacerbations of COPD, 2.3% for neurological events, 2% for melena, 1.6% for diverticulitis, 1.6% for lower limbs critical ischemia, 1.6% for hypertensive crisis, 1.6% for dehydration, 1.6% for lumbar pain, 1.2% for bradycardia, 1.2% for abdominal pain, 1.2% for pulmonary embolism, 0.8% for deep venous thrombosis and 9.4% for other reasons.

	N	Media \pm DS	Range
Age (years)	255	81.05 \pm 7.29	65-97
Weight (Kg)	255	70.19 \pm 15.15	36.5-140
BMI (Kg/m^2)	255	25.55 \pm 5.15	16-53
ADL/6	255	4.96 \pm 1.76	0-6
IADL/8	255	5.16 \pm 2.75	0-8
MMSE/30	255	25.5 \pm 4.72	Jul-30
MNA/30	255	24.6 \pm 5.99	Jun-30
Barthel index	255	53.84 \pm 27.62	0-100
SPPB overall score (0-12)	255	4.69 \pm 4.15	0-12
Time to perform the gait speed test (sec)	169	6.84 \pm 3.36	Mar-20
Time to perform chair stand test (sec)	169	20.73 \pm 15.2	10-100
Handgrip (Kg)	255	18.14 \pm 8.44	Jan-46

Table 1: Characteristics of the study population.

Subjects in which it was possible to perform the gait speed test ($n=169$, 37.3% female) compared to those where it was not possible, were older, more lean and with a significantly lower ADL score.

The subgroup of subjects able to SPPB had a handgrip test performance significantly higher compared to those unable to perform SPPB (data not shown in Table). Comparing subjects who refused to participate to the study to those involved, no significant difference in age or BMI was observed (data not shown in Table).

A significant increase in the time to perform the 4 meters walking and the chair stand test, as well as in the Barthel index was observed ($p<0.001$ for all, Table 2). In particular, the time to perform the walking test increased by about 0.7 seconds while that to perform the chair stand test by about 1.6 seconds (Table 2). A reduction of

handgrip strength values of about 0.7 kg was also observed ($p < 0.001$). Tables 3 and 4 shows performance tests, handgrip and Barthel changes between the beginning and the end of the hospitalization, respectively, in males and females. No significant differences between the males and females in performance and muscle strength loss were observed.

Subjects who during hospitalization showed worsening in Barthel had significantly greater worsening in SPPB overall score and handgrip (data not shown in Table) (Figure 1).

Dividing the population according to MNA score, individuals with score indicative of malnutrition or at risk for malnutrition presented a chair stand test performance worsening significantly greater than subjects with normal nutritional status ($p < 0.01$).

These subjects had a borderline worsening in gait speed performance compared to subjects with normal MNA ($p = 0.117$), while no significant differences were observed for the other variables considered.

	N	Mean ± SD admittance	Mean ± SD discharge	Delta	p
Time to perform Chair Stand (sec)	169	20.73 ± 15.20	22.35 ± 15.96	+1.619	<0.001
Time to perform Gait Speed (sec)	169	6.84 ± 3.62	7.56 ± 3.69	+0.725	<0.001
SPPB overall score (0-12)	255	4.80 ± 4.25	4.36 ± 4.17	-0.329	=0.001
Barthel	255	54.25 ± 27.57	62.86 ± 28.17	+8.607	<0.001
Handgrip (Kg)	255	18.14 ± 8.44	17.47 ± 8.44	-0.67	< 0.001

SPPB=short physical performance battery.

Table 2: Physical performance, handgrip and Barthel index changes in the study population.

	N	Mean ± SD admittance	Mean ± SD discharge	Delta	p
Time to perform Chair Stand (sec)	106	16.42 ± 7.62	17.72 ± 8.49	1.304	<0.001
Time to perform Gait Speed (sec)	106	6.24 ± 3.22	6.95 ± 3.681	0.707	<0.001
SPPB overall score (0-12)	156	5.38 ± 4.78	4.81 ± 4.38	-0.571	<0.001
Barthel	156	57.26 ± 28.15	65.34 ± 30.08	8.082	<0.001
Handgrip (Kg)	156	21.97 ± 7.58	21.29 ± 7.741	-0.673	< 0.01

Table 3: Physical performance, handgrip and Barthel index changes in males.

	N	Mean ± SD admittance	Mean ± SD discharge	Delta	p
Time to perform Chair Stand (sec)	63	28.22 ± 21.17	30.38 ± 21.81	2.16	0.034

Time to perform Gait Speed (sec)	63	7.84 ± 3.36	8.60 ± 3.5	0.756	<0.001
SPPB overall score (0-12)	99	3.88 ± 3.42	3.67 ± 3.72	-0.051	0.031
Barthel	99	49.78 ± 26.2	59.17 ± 24.78	9.389	<0.001
Handgrip (Kg)	99	12.09 ± 5.797	11.43 ± 5.46	-0.665	<0.001

Table 4: Physical performance, handgrip and Barthel index changes in females.

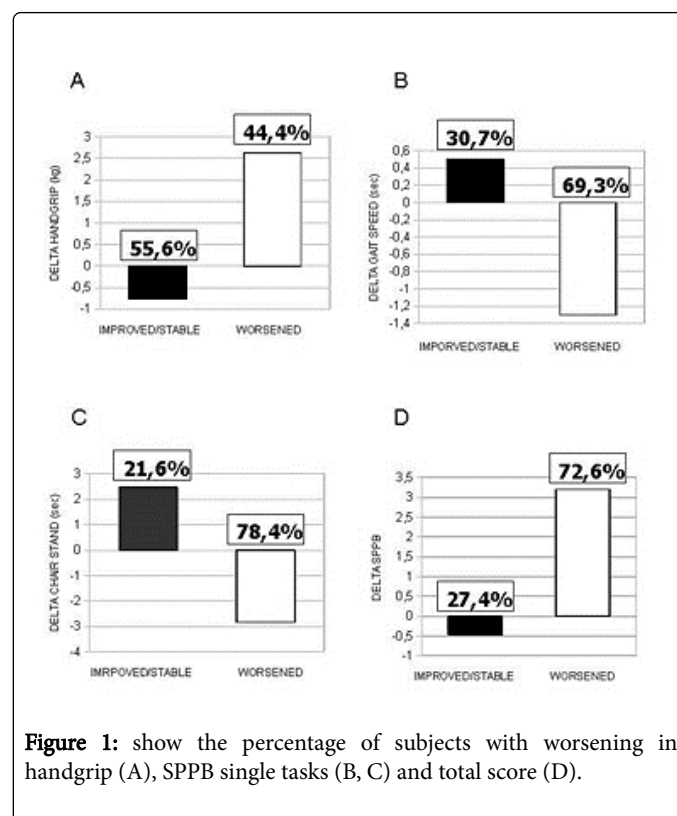


Figure 1: show the percentage of subjects with worsening in handgrip (A), SPPB single tasks (B, C) and total score (D).

Discussion

Our study show, in a group of elderly patients admitted to an acute care geriatrics unit, that hospitalization despite a clinical improvement, determines physical performance and muscle strength loss.

In particular, a worsening in each task as well as in the total score of the SPPB and between hospital admission and discharge, whilst no difference between the two sexes was observed. Individuals with score indicative of malnutrition or at risk for malnutrition presented a chair stand test performance steeper decline.

In our population a worsening in each task as well as in the total score of the Short Physical Performance Battery was observed between hospital admission and discharge. Covinsky et al. have shown that the degree of autonomy, as evaluated with ADL, decrease during hospitalization [3]. Only few studies have evaluated physical performance in patients hospitalized and the prognostic significance of the degree of disability on the risk of rehospitalization and mortality [12,20], but only one measured physical performance at the entrance to the hospital and changes during hospitalization. Volpato et al. [21]

evaluated 92 patients at hospital admission and discharge, assessing the overall SPPB score. They observed an impairment in the score in 63%, 17% were stable and only 19% worse. In contrast our data show that the majority of patients show a performance loss during hospitalization. Many differences can be remarked between our study and the one of Volpato and could partially account for the different results observed. In fact, in the study sample of Volpato is smaller and patients included in the study were selected based on admission diagnosis (heart failure, COPD and minor stroke) [21]. However, from a comparison based on admission diagnosis no significant differences in performance and strength loss were observed.

It should also be noted that the variations in SPPB single items were not considered by Volpato, but only the overall score. Finally, in the study of Volpato et al. muscle strength change was not considered [21]. It is also important to note that our population has higher mean age and a lower SPPB score compared to the Volpato study population in which more than 50% of subjects had a score above 8.

The results of our study showed that, despite observed physical performance and muscle strength worsening observed during hospitalization, the Barthel index, and thus the degree of autonomy, significantly improved. Dividing the study population on the basis of Barthel index changes, patients with index reduction, compared with those who remain stable or show improvement during hospitalization, are those that experience the steeper decrease in SPPB score and handgrip worsening, suggesting that the most fragile patients and therefore more prone to lose performance and muscle strength are also those at higher risk of autonomy loss during hospitalization. Geriatric hospitalized patients undergoes a decrease of appetite resulting in reduced food intake [22]; this generally is associated with a decline in physical activity that accelerate muscle mass loss [23]. Sarcopenia is one of the main factors responsible for the reduction in functional capacity. Malnutrition adversely affects the progression of sarcopenia, the risk of morbidity and mortality. Our data show that patients with MNA indicative of malnutrition or of risk of malnutrition compared with normal subjects show a steeper reduction in chair stand performance. These results seem to suggest that the elderly patient's nutritional status influence performance loss during hospitalization. Hospitalization is related to rapid loss of muscle mass due to the reduced level of physical activity or bed rest [23] which is not accompanied by an increased protein synthesis [24]. It is therefore useful to identify at hospital admission fragile malnourished patients, at higher risk for muscle mass and physical performance loss during hospitalization to implement a strategy based on prevention and protein supplementation and/or program of strengthening exercises [24,25]. Moreover, in the population at risk for malnutrition caloric intake should be monitored and early mobilization in armchair encouraged.

Some limitations of our study must be acknowledged. First of all, loss of muscle mass was not evaluated in our population. However, it has previously been observed [26] that performance worsening and muscle strength loss occur earlier and are more relevant from a clinical point of view than muscle mass loss itself. Last, performance test was not available for all the subjects.

In conclusion, our study show a worsening in each task as well as in the total score of the SPPB and between hospital admission and discharge. No difference between the two sexes was observed. Individuals with score indicative of malnutrition or at risk for malnutrition presented a chair stand test performance steeper decline.

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