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Prevalence of sarcopenia in acute hip fracture patients and its influence on short-term clinical outcome

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Aim: Current international criteria provide standardized procedures to diagnose sarcopenia in older people. However, to date few data exist on patients with acute disease. The present study was carried out to determine the frequency of sarcopenia in acute hip fracture patients, and its association with their baseline characteristics and prognosis during hospitalization.

Methods: Data were collected from 509 consecutive patients hospitalized for hip fracture. The European Working Group on Sarcopenia in Older People Criteria for sarcopenia were applied in the first 72 h. Muscle mass was measured by electrical bioimpedance and grip strength by hydraulic dynamometer. Clinical, functional and cognitive characteristics were assessed at baseline and hospital discharge, and their association with the presence of sarcopenia was studied.

Results: A total of 479 patients (94%) met the inclusion criteria. The mean age was 85.3 (SD 6.8 years). The frequency of sarcopenia was 17.1% (12.4% in men, 18.3% in women). Sarcopenia was associated with residence in nursing homes (30.5% *vs* 19.6%, $P = 0.030$), older age (86.8, SD 6.2 *vs* 85.1, SD 6.9 years, $P = 0.038$), and lower body mass index (23.1, SD 3.6 *vs* 25.6, SD 4.23, $P < 0.001$). In the multivariate analysis, only low body mass index was predictive of sarcopenia (OR 0.85, 95% CI 0.80–0.91). Sarcopenia was associated with worse functional prognosis at discharge in the crude analysis (OR 1.88, 95% CI 1.15–3.07), but not in the multivariate analysis (OR 1.68, 95% CI 0.99–2.84).

Conclusions: Sarcopenia was detected in almost one of five acute hip fracture patients and was associated with lower body mass index, but an association with worse prognosis at discharge could not be confirmed. **Geriatr Gerontol Int 2016; 16: 1021–1027.**

Keywords: cohort, hip fracture, older people, orthogeriatrics, sarcopenia.

Introduction

Although the progressive decline in skeletal muscle mass known as sarcopenia has been known for decades, it was not until publication of the Report of the European Working Group on Sarcopenia in Older People (EWGSOP) in 2010 that an operational definition by consensus criteria was standardized.[1] These criteria require the detection of low muscle mass as well as measurement of low muscle strength and/or low physical performance. Computed tomography and magnetic resonance imaging are considered the gold standard for estimating muscle mass, while dual energy X-ray absorptiometry and bioelectrical impedance analysis (BIA) are acceptable alternatives. For the estimation of muscle strength, assessment of handgrip strength is an appropriate procedure.

The application of unified criteria has made it possible to know and compare the prevalence of sarcopenia in different populations of older people.[2] Data on the prevalence of sarcopenia in community-dwelling residents or nursing homes are widely available, with reported frequencies of 1–29% and 14–33%, respectively, but less information exists on hospitalized elderly people.[2] The review published by the International

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Sarcopenia Initiative (EWGSOP and the International Working Group on Sarcopenia) identified only one study of sarcopenia in hospitalized older adults, in which the frequency was 10%.[3]

Data are even scarcer on the frequency and effect of sarcopenia in patients with specific diseases, such as patients with hip fracture (HF). The number of older people affected by this condition is high. In Europe, there are approximately 620 000 new cases of HF per year, and these are associated with considerable mortality and disability.[4] Approximately 20% of such cases die during the post-fracture year, and less than half of those who survive regain their previous functional level.[5] Thus, it is interesting to identify the factors that influence the clinical course of these patients, which might include sarcopenia.

Evaluation of sarcopenia in patients with HF involves some difficulties, such as those caused by their mobility problems or the choice of method to measure muscle mass. This could be why few studies have been carried out either in the acute phase,[6–8] or in the subacute or chronic phases.[9–11] To our knowledge, only one study has applied the EWGSOP criteria.[12] The rest only measure muscle mass, without evaluating function, and thus do not meet the EWGSOP criteria. Furthermore, with few exceptions they include very few cases.[6,11]

The aim of the present study was to determine the prevalence of sarcopenia in a large consecutive series of patients with HF, and to identify the variables associated with the disorder in these patients and their clinical course during hospitalization.

Materials and methods

Participants and setting

All patients aged 65 years and older consecutively hospitalized in a public 1300-bed university hospital with a diagnosis of fragility HF between 25 January 2013 and 26 February 2014 were included. This hospital has a catchment area of approximately 500 000 inhabitants. HF patients are admitted from the emergency department to the Orthogeratric Unit, whose activities have been described previously.[13,14]

Patients hospitalized in this unit receive a comprehensive geriatric assessment and study of their fall at the time of admission, and are treated during hospitalization jointly by the orthogeriatrician, orthopedic surgeon and orthogeriatric nurse. Patients are helped to get out of bed on the day after surgery and are asked to bear their own weight on the second day. The physiotherapist treats the patients in the same room where they are hospitalized. The orthogeriatric team plans the discharge and assesses the need for referral to a geriatric rehabilitation unit after discharge. During the hospital stay, patients receive routine orthogeriatric care, and a standardized protocol (known as FONDA for Function, Osteoporosis, Nutrition, Pain [*Dolor* in Spanish] and Anemia) is applied. The aim is to optimize physical function (active and passive exercises in bed and in a chair from the time of admission, and standing after surgery), bone health (early normalization of vitamin D plasma levels), nutrition (nutritional supplements in cases of hypoproteinemia or body mass index <24 kg/m^2), pain (analgesia scheduled every 4 h) and anemia (administration of intravenous iron if ferropenia is detected and transfusion of packed red blood cells if hemoglobin is <9 g/dL or <10 g/dL in patients with disease of a vital organ).

Assessment

All patients were assessed before surgery, in the first 72 h after admission. A clinical interview was administered to collect data on the following baseline variables: clinical (previous illnesses and treatments), functional (previous Functional Ambulation Category [FAC] scale and Barthel Index [BI]), cognitive (Pfeiffer's SPMSQ) and analytic (hemogram and biochemistry, total protein, albumin, vitamin D). Muscle mass and grip strength were also assessed at this time.

In the last 24 h before discharge, variables were collected on function (FAC scale and BI) and cognition (Pfeiffer's SPMSQ) and the post-discharge destination. As an outcome variable, the proportion of BI lost at discharge was calculated using the following formula: previous BI – discharge BI / previous BI.

The study was approved by the Clinical Research Ethics Committee of the Hospital Universitario La Paz (Reference HULP-PI-1334). An informed consent form was obtained from patients or relatives before their inclusion in the study.

Skeletal muscle index

Body mass index (BMI) was calculated. Weight registered in the primary health care records, and in the cases that it was not available, the last weight self-referred by the patients or their relatives was used. Height was estimated from tables of height as a function of ulna length.[15] Muscle mass was calculated by BIA with the patient in supine position. Resistance was measured in the first 72 h after admission with a BIA device (BIA-101; AKERN srl, Pontassieve, Fi, Italy), placing the electrodes on the hand and foot opposite the fracture. Skeletal muscle mass (SMM) was calculated using Janssen's formula: (SMM [kg] = [{Ht^2/R} × 0.401] + [sex× 3.825] – [age × 0.071] + 5.102).[16] Then, the skeletal muscle index was calculated (SMI = SMM [kg] / height^2). Muscle mass was considered to be low when it was below the cut-offs validated in elderly Spaniards: SMI <6.68 kg/m^2 in women and <8.31 kg/m^2 in men.[17]

Muscle strength

Grip strength was measured in the dominant hand using a Jamar hydraulic dynamometer (Sammons Preston, Bolingbrook, IL, USA), following the modified Southampton protocol.[18] The cut-off points of the inCHIANTI study were applied, that is, 20 kg for women and 30 kg for men.[1,19]

Diagnosis of sarcopenia

A patient was considered to have sarcopenia if he/she met the EWGSOP criteria for low muscle mass and low muscle strength.[1] Because these patients had not yet undergone surgery for the fracture, it was not possible to apply the gait speed criterion. The assessment of SMI was included first in the algorithm and then the results of grip strength were included. It was made this way in order to minimize a potential loss of subjects, as in samples with very aged patients and with high prevalence of cognitive impairment some of them might not be able to accomplish the instructions for grip strength assessment, but most of them can be assessed by BIA.

Statistical analysis

The results for the quantitative variables are described by the mean and standard deviation (SD), except for BI, which is by median and interquartile rage (IQR), and those for qualitative variables by the absolute and relative frequency. A bivariate analysis was made comparing the results for participants with and without sarcopenia. Student's *t*-test or the Mann–Whitney test were applied for quantitative variables, and the χ^2-test for qualitative variables. Two multiple logistic regression analyses were carried out: in the first model, the dependent variable was sarcopenia, and the independent variables were age, sex and the variables that were associated in the bivariate analysis; the second model used as the dependent variable the proportion of BI lost at discharge dichotomized by the median, and as independent variables age, sex, sarcopenia and BMI. This association was summarized with odds ratios (OR) and their respective confidence intervals (95% CI). The statistical package used was SPSS, version 22 (IBM, Armonk, NY, USA).

Results

A total of 509 patients were hospitalised during the study period, of whom 214 (42%) had an intracapsular fracture and 295 (58%) had an extracapsular fracture. A total of 490 patients (96.3%) underwent surgery, 184 (37.6%) by implantation of prostheses, 268 (54.7%) by osteosynthesis with intramedullary nails and 38 (7.8) with other techniques.

A total of 30 (5.8%) patients were excluded for various reasons (refusal to participate, died before assessment, had surgery before measurement of muscle mass or grip strength; Fig. 1). Out of the 479 cases included, 82 (17.1%) had both low muscle mass and low muscle strength (Table 1). The prevalence by sex was 12.4% in men and 18.3% in women.

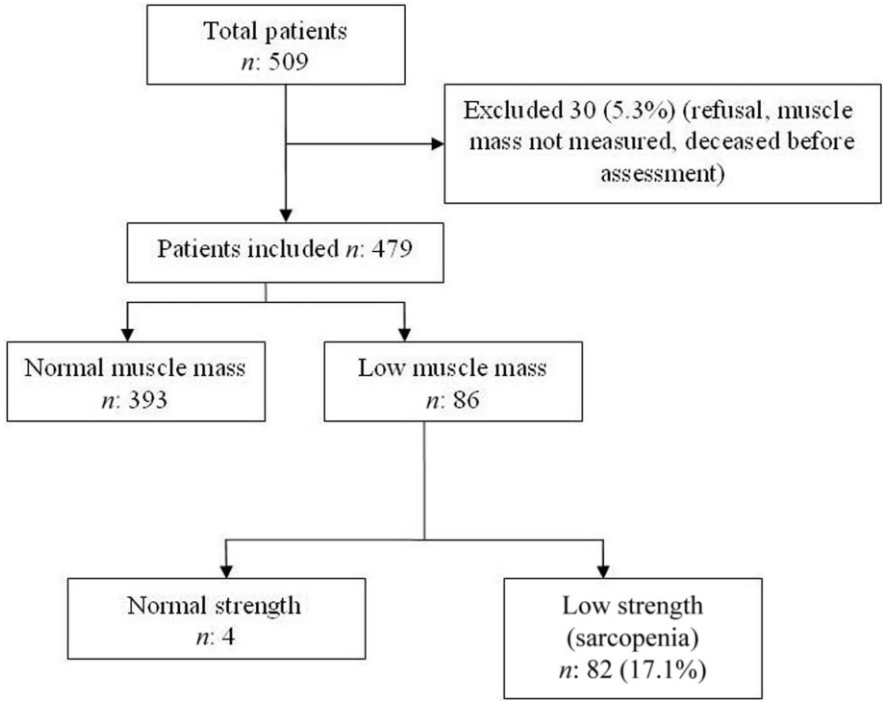

Figure 1 Study flow chart applying algorithm with European Working Group on Sarcopenia in Older People Criteria for the diagnosis of sarcopenia in a sample of 509 consecutive patients admitted with an acute hip fracture.

Table 1 Characteristics of patients from the total sample and according to the presence or absence of sarcopenia by European Working Group on Sarcopenia in Older People Criteria

Baseline		Total sample (n = 479)	No sarcopenia n = 397(82.9%)	Sarcopenia n = 82 (17.1%)	P
Age (years)		85.3 (6.8)	85.1 (6.9)	86.8 (6.2)	0.038
Women		382 (79.7%)	312 (78.6%)	70 (85.4%)	0.164
Living in nursing homes		103 (21.5%)	78 (19.6%)	25 (30.5%)	0.030
Previous FAC	0	17 (3.5%)	15 (3.8%)	2 (2.4%)	0.621
	1, 2, 3	77 (16.1%)	66 (16.6%)	11(13.4%)	
	4, 5	385 (80.4%)	316 (79.6%)	69 (84.1%)	
Previous BI		85 (65–95)	90 (65–100)	80 (65–90)	0.124
BI at admission		10 (0–20)	10 (0–20)	10 (0–20)	0.333
SPMSQ at admission ≥3		251 (54.1%)	203 (52.7%)	48 (60.8)	0.192
Surgical risk: ASA III–IV		335 (69.9%)	276 (69.5%)	59 (72.0)	0.662
Body mass index (kg/m^2)		25.2 (4.2)	25.6 (4.2)	23.1 (3.6)	<0.001
SMI (kg/m^2)		8.8 (2.3)	9.4 (2.2)	6.2 (0.8)	<0.001
Low SMI†		86 (18.0%)	4 (1%)	82 (100%)	<0.001
Grip strength (kg)		13.2 (6.8)	13.8 (7.1)	10.9 (4.8)	0.010
Low grip strength‡		399 (91.1%)	317 (89%)	82 (100%)	0.002
Total serum protein (g/dL)		6.8 (0.8)	6.8 (0.8)	6.9 (0.9)	0.450
Albumin (g/dL)		3.1 (0.4)	3.1 (0.4)	3.2 (0.4)	0.387
Vitamin D (ng/mL)		16.3 (12.5)	15.9 (11)	17.9 (18.1)	0.342
At discharge					
FAC at discharge	0	78 (17.0%)	66 (17.4%)	12 (14.8%)	0.424
	1, 2, 3	367 (79.8%)	299 (78.9%)	68 (84%)	
	4, 5	15 (3.3%)	14 (3.7%)	1 (1.2%)	
Discharge BI		35.5 (18.8)	36.1 (19.1)	32.3 (17.7)	0.095
Proportion of BI lost		55.9 (20.5)	54.7 (20.3)	59.5 (17.9)	0.051
SPMSQ ≥3		250 (56.2%)	203(55.2)	47(61)	0.345
Presurgery stay (days)		3.2 (2.2)	3.2 (2.2)	3.25 (2)	0.751
Total acute stay (days)		10.1 (5)	10.32 (5.2)	9.5 (3.7)	0.172
Discharge destination					
Own home		123 (25.7%)	106 (26.7%)	17 (20.7%)	0.292
Nursing home		118 (24.6%)	91 (22.9%)	27 (32.9%)	
Rehabilitation unit		206 (43.0%)	171 (43.1%)	35 (42.7%)	
Long-term care/other		10 (2.1%)	9 (2.3%)	1 (1.2%)	
Deceased		19 (4%)	18 (4.5%)	1 (1.2%)	
Other		3 (0.6%)	2 (0.5%)	1 (1.2%)	

Data shown as mean (SD) and n (%); for Barthel Index as median (interquartile range). †Low skeletal mass index (SMI): men with SMI ≤8.31 + women with SMI ≤6.68. ‡Low grip strength: men with <30 kg and women with <20 kg (41 patients were unable to carry out the test). ASA, American Society of Anesthesiologists; BI, Barthel Index; FAC, Functional Ambulation Category Scale; Proportion of BI lost, previous Barthel Index – discharge Barthel Index/previous Barthel Index. SMI, skeletal mass index; SPMSQ, Pfeiffer's Short Portable Mental Status Questionnaire (15 patients were unable to complete it).

The results of the bivariate analysis of baseline variables (Table 1) showed that patients with sarcopenia were slightly older, more often resided in nursing homes and had lower BMI. The multivariate analysis (Table 2) showed that BMI was independently associated with sarcopenia, but not with the rest of the baseline variables that were associated in the bivariate analysis.

Regarding the variables at discharge, sarcopenia was significantly associated with the proportion of BI lost at discharge, with a crude odds ratio of 1.88 (95% CI 1.15–3.07; Table 2). Although the association remained in the multivariate analysis, it was on the margins of statistical significance (adjusted OR 1.68; 95% CI 0.99–2.84).

Table 2 Results of the multivariate analysis in a sample of 479 patients hospitalized with acute hip fracture

Crude and fully adjusted OR between selected baseline variables and the presence of sarcopenia						
	Crude OR			Fully adjusted OR		
	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Age	1.04	1.00–1.08	0.039	1.02	0.99–1.06	0.219
Sex (ref: male)	1.58	0.82–3.07	0.167	1.53	0.78–3.02	0.218
Previous place of residence (ref: Own home)	1.79	1.05–3.05	0.031	1.44	0.82–2.54	0.207
Body mass index	0.84	0.79–0.91	0.000	0.85	0.80–0.91	<0.001
Crude and fully adjusted OR between sarcopenia and selected baseline variables and Barthel Index lost at discharge						
Sarcopenia	1.88	1.15–3.07	0.011	1.68	0.99–2.84	0.053
Age	1.11	1.07–1.14	0.000	1.10	1.07–1.14	<0.001
Sex (ref: Male)	1.09	0.70–1.07	0.685	0.92	0.56–1.50	0.733
Body mass index	0.99	0.95–1.03	0.533	1.00	0.96–1.05	0.889

OR, odds ratio calculated with logistic regression.

Discussion

In the present study, we found that the prevalence of sarcopenia according to the EWGSOP criteria in a sample of patients hospitalized for acute hip fracture was 17.1%. By sex it was 12.4% in men and 18.3% in women.

Even though this frequency of sarcopenia is within the wide range described in the general population of older adults,[2] in our series the frequency is especially low in men, perhaps because of the cut-offs used for SMI,[17] which are higher than the used in other studies of sarcopenia. These SMI cut-offs have been established from a Spanish reference population of older people, which is the best benchmark we have in our case. In the publication of Spanish cut-offs, it was already found that the prevalence of sarcopenia in Spanish men was lower than in other countries, specifically two- or three-fold less than in French or Chinese men.[17]

It is not easy to compare the present results with other studies in patients with HF, because most such studies have not applied the EWGSOP criteria, given that they only quantify muscle mass.[6–11] The only study to apply the EWGSOP criteria found a frequency of sarcopenia in HF patients of 24% in the 3 months after the fracture.[12] Of the remaining studies, some included patients with subacute or chronic HF, weeks or months after the fracture, and showed a high prevalence of low muscle mass (65–70%);[9–11] however, the relative immobilization after HF in this period might lead to greater loss of muscle mass. There are other studies that did include patients in the first hours or days after the fracture. In two such studies that used dual energy X-ray absorptiometry to measure low muscle mass, one found a prevalence of 16.4% in women and 70.6% in men,[8] whereas the other reported 44.7% in women and 81.1% in men.[6] One work using BIA found a frequency of low muscle mass of 7%.[7] Overall, the present results on low muscle mass (18%) are within the wide range of figures estimated to date.

There are other studies that have applied the EWGSOP criteria in samples of patients hospitalized for conditions other than HF, and reported frequencies of sarcopenia of 10–28%[3,20,21] in both sexes, and up to 55% in men.[22]

In the present study, the presence of sarcopenia was associated with some baseline characteristics, such as older age, residence in a nursing home and having lower BMI, but in the multivariate analysis only BMI remained associated with it.

At discharge, sarcopenia showed an association with greater functional loss in the crude analysis, but in the multivariate analysis this association lost significance, and age was the only variable that remained associated with functional loss. In the orthogeriatric unit where our study was carried out, mortality is low and hospital stay is brief, therefore it might not be easy to find differences among patients in these parameters. Furthermore, the lack of strength in the association of sarcopenia could be due to the fact that patients receive a high standard of clinical and orthogeriatric care, including aspects related to sarcopenia, such as nutrition and physical exercise. We cannot compare the results with other studies of acute HF, but those carried out with acute geriatric patients have found associations with longer hospital stay, higher in-hospital mortality and, the same as in our study, lower BMI.[5,21,23]

One strength of the present study was the large number of cases studied. As far as we know, only one study of sarcopenia in HF patients has included over

500 cases.[11] Furthermore, our study can be considered to include all HF patients over the course of 1 year in an area with over 500 000 inhabitants, as ours is the only public hospital that admits HF patients, and these patients do not usually go to private centers. Another strength is that the cut-off point used to categorize low muscle mass was taken from a validation study carried out in older persons in Spain.[17]

Among the study limitations were those related to the difficulty of assessing sarcopenia in acute HF patients. In the first place, gait speed cannot be assessed before surgery, therefore application of the functional criteria is limited to measuring muscle strength. Second, the use of BIA to measure muscle mass is subject to debate, because it is less precise than other procedures. Some expert consensus groups accept its use,[1,24] but not all do so.[25,26] Correlation studies of measurements made using BIA and magnetic resonance imaging and dual energy X-ray absorptiometry were made in samples of young adults, and there are questions about their validity when applied to older people.[16,27,28] Nevertheless, many studies of sarcopenia in older individuals have been made using this technique,[2] even in acute patients.[6,20,22]

The choice of the time to study sarcopenia after HF also gives rise to some difficulties. Most studies have measured muscle mass in postoperative, subacute or chronic phases, and hardly any data are available on the phase immediately after the HF. In principle, the first hours or days seem to be an appropriate time, as muscle mass is maintained during the first 10 days, although it subsequently diminishes.[29,30]

Finally, the fracture of a long bone with secondary bleeding and the need to provide fluids might alter body composition. The only ideal way to solve this problem would be to measure muscle mass in the minutes or hours immediately after the fracture, which is not always possible. We considered the maximum limit to be 72 h, accepting the variability that this might involve. Changes after HF are believed to involve some degree of dehydration, which could lead to an overestimation of sarcopenia.

In conclusion, the present study found that the frequency of sarcopenia in acute HF patients was 17.1%, and that sarcopenia was associated with lower BMI. Based on our data, a consistent association between sarcopenia and worse functional outcome at discharge cannot be confirmed, nor can we rule out a possible effect. Further studies are required to assess the prevalence of this condition in acute HF patients, and to confirm whether sarcopenia affects the clinical course of these patients over the short or long term.

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Disclosure statement

No potential conflicts of interest were disclosed.

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