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ARTICLE

Prevalence of malnutrition in a cohort of 509 patients with acute hip fracture: the importance of a comprehensive assessment

M Díaz de Bustamante[1], T Alarcón[1,2,3], R Menéndez-Colino[1,2], R Ramírez-Martín[1], Á Otero[2,3,4] and JI González-Montalvo[1,2,3]

BACKGROUNDS/OBJECTIVES: Malnutrition is very common in acute hip fracture (HF) patients. Studies differ widely in their findings, with reported prevalences between 31 and 88% mainly because of small sample sizes and the use of different criteria. The aim of this study was to learn the prevalence of malnutrition in a large cohort of HF patients in an comprehensive way that includes the frequency of protein–energy malnutrition, vitamin D deficiency and sarcopenia.

SUBJECTS/METHODS: A 1-year consecutive sample of patients admitted with fragility HF in a 1300-bed public University Hospital, who were assessed within the first 72 h of admission. Clinical, functional, cognitive and laboratory variables were included. Energy malnutrition (body mass index (BMI) <22 kg/m^2), protein malnutrition (serum total protein <6.5 g/dl or albumin <3.5 g/dl), vitamin D deficiency (serum 25-OH-vitamin D <30 ng/dl) and sarcopenia (low muscle mass plus low grip strength) were considered.

RESULTS: Five hundred nine HF patients were included. The mean age was 85.6 ± 6.9 years and 79.2% were women. Ninety-nine (20.1%) patients had a BMI <22 kg/m^2. Four hundred nine patients (81.2%) had protein malnutrition. Eighty-seven (17.1%) patients had both energy and protein malnutrition. Serum vitamin D was <30 ng/ml in 466 (93%) patients. The prevalence of sarcopenia was 17.1%.

CONCLUSIONS: Protein malnutrition and vitamin D deficiency are the rule in acute HF patients. Energy malnutrition and sarcopenia are also common. A nutritional assessment in these patients should include these aspects together.

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INTRODUCTION

Hip fracture (HF) has an annual incidence of around 620 000 cases in the European Union and > 210 000 in the United States.[1,2] Its effects are devastating to patient quality of life and survival. After a HF, a significant number of patients do not recover their previous functional status or will need support for long periods of time.[3] In addition, the mortality rate after a HF doubles that of individuals of the same age without a fracture and the excess mortality is maintained for years.[4]

The rate of malnutrition in acute HF patients is very high, but the existing data are incomplete and highly variable with rates of protein–energy malnutrition between 31 and 88%.[5] The studies published in the literature use different criteria to define malnutrition: anthropometric measurements, laboratory results, nutritional screening questionnaires, subjective interviews[6] and intake measurements,[7] among others. There is no definitive consensus on the diagnosis of malnutrition in HF patients, which explains this variability and the difficulty in therapeutic management. To our knowledge, the majority of published studies on malnutrition in HF include small samples or they exclude some types of patients, meaning they cannot be representative of all cases. Some just analyse laboratory parameters or results from questionnaires.[8–14] Others provide data on the rate of sarcopenia[15–17] or vitamin D deficiency.[18,19]

The problem is significant as malnutrition following HF is accompanied by an increased risk of complications, poorer functional recovery, delayed healing of the surgical wound and even an increased risk of mortality.[8–10,20] Optimising detection and correction may be key to improving progress in these patients.

The purpose of this study was to learn the prevalence of malnutrition in a large cohort of HF patients in a comprehensive way that includes the frequency of protein–energy malnutrition, vitamin D deficiency and sarcopenia.

MATERIALS AND METHODS

Patients and setting

All patients aged 65 or over, consecutively hospitalised in a public 1300-bed University Hospital with a diagnosis of acute fragility HF between 25 January 2013 and 26 February 2014, were included. This hospital has a catchment area of about 500 000 inhabitants. HF patients were admitted from the Emergency Department to the Orthogeriatric Unit, the activities of which have been described previously.[21]

Patients hospitalised in this unit received a comprehensive geriatric assessment and study of their fall at the time of admission and were co-managed jointly by the orthogeriatrician, orthopaedic surgeon and orthogeriatric nurse. During the hospital stay, patients received routine orthogeriatric care and a standardised protocol (known as FONDA: function, osteoporosis, nutrition, pain (*Dolor* in Spanish) and anaemia)

[1]Geriatrics Department, Hospital Universitario La Paz, Madrid, Spain; [2]La Paz University Hospital Research Institute, IdiPAZ, Madrid, Spain; [3]RETICEF, Spain and [4]Preventive Medicine Department, Universidad Autónoma de Madrid, Madrid, Spain. Correspondence: Dr MD de Bustamante, Geriatrics Department, Hospital Universitario La Paz, Paseo de la Castellana, 261, Madrid 28046, Spain.
E-mail: macadbu@gmail.com
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was applied. The aim was to optimise treatments aimed at improving physical function, bone health, nutritional state, pain control and correction of anaemia.

Patient assessment

All patients were assessed within the first 72 h after admission, usually within the first 24 h, always before surgery. Demographic (age, sex and, previous living situation) and clinical (type of fracture and surgical risk according to the American Society of Anesthesiologists (ASA) classification) data were collected. A clinical interview was carried out to collect data on the baseline clinical, functional (previous Functional Ambulation Category Scale[22] and Barthel index[23]), cognitive (Pfeiffer's Short Portable Mental Status Questionnaire[24]) and laboratory variables. Muscle mass and grip strength were also assessed at this time.

To calculate body mass index (BMI), weight recorded in the Primary Health Care records was used and in cases in which this was not available, the last weight self-stated by the patient or their relatives was used. Height was estimated from tables using height as a function of ulna length.[25] The nutritional laboratory parameters collected on admission were albumin, total protein, ferritin, C-reactive protein and vitamin D (25-OHD). Serum 25-OH-vitamin D was measured using a direct competitive chemiluminescence immunoassay in a LIAISON System (DiaSorin, Stillwater, MN, USA). Serum intact parathyroid hormone was measured using a two-site chemiluminescent enzyme-labelled immunometric assay in an IMMULITE 2500 System (Siemens, Tarrytown, NY, USA). Muscle mass was calculated in the first 72 h after admission with a BIA device (BIA-101, AKERN srl, Pontassieve, Fi, Italy) as has been described previously.[26] Grip strength was measured in the dominant hand using a Jamar hydraulic dynamometer (Sammons Preston, Bolingbrook, IL, USA).

A BMI $<22\ \text{kg/m}^2$ was used to determine energy malnutrition[27] and protein malnutrition was defined as a total protein value <6.5 g/dl and/or albumin <3.5 g/dl. Vitamin D deficiency was diagnosed when levels were below 30 ng/ml. A patient was defined as having sarcopenia if he/she met the EWGSOP criteria for low muscle mass and low muscle strength.[28,29] Low muscle mass was diagnosed when the skeletal mass index was below the cutoffs validated in elderly Spaniards: skeletal mass index $<6.68\ \text{kg/m}^2$ in women and $<8.31\ \text{kg/m}^2$ in men.[29] For muscle grip strength, the cutoff points from the inCHIANTI study were applied, meaning 20 kg for women and 30 kg for men.[29]

Table 1. General characteristics of the sample of patients admitted for hip fracture ($n=509$)

Age (years)	85.6 (6.9)
Women	403 (79.2%)
Types of fractures	
Intracapsular	214 (42%)
Extracapsular	295 (58%)
Living in nursing homes	116 (22.8%)
FAC	
0	18 (3.5%)
1, 2, 3	88 (17.2%)
4, 5	403 (79.2%)
Barthel index	77 (24)
Pfeiffer's SPMSQ ≥ 3	220 (43.2%)
Surgical risk, ASA III–IV	358 (70.3%)
Surgical intervention	490 (96.3%)
Mean stay (days)	
Total	10.1 (5.0)
Preoperative ($n=490$)	3.2 (2.2)
Destination at discharge	
Home	126 (24.8%)
Nursing home	132 (25.9%)
Geriatric rehabilitation unit	217 (42.6%)
Long-stay unit	10 (2.0%)
Deaths	21 (4.1%)
Other	3 (0.6%)

Abbreviations: ASA, American Society of Anesthesiologists; FAC, Functional Ambulation Category Scale; Pfeiffer's SPMSQ, Short Portable Mental Status Questionnaire. Data shown as mean (s.d.) or *n* (%).

Statistics

The results were described using the mean and s.d. in the case of quantifiable variables and absolute and relative frequency in the case of qualitative variables.

Ethical approval

The study was approved by the Clinical Research Ethics Committee at Hospital Universitario La Paz (Reference HULP-PI-1334). Patients and relatives were informed about the nature of the study, and an informed consent form was obtained from them in the first 72 h from admission, before their inclusion in the study.

RESULTS

A total of 535 acute HF patients were hospitalised during the study period. Twenty-six (4.8%) were lost to follow-up, denied consent or died before assessment. In all, 509 patients were included. The mean patient age was 85.6 ± 6.9 years and 403 (79.2%) were women (Table 1). The majority (79.2%) walked independently before the HF. Upon admission, 220 (43.2%) had cognitive deterioration. Four hundred ninety patients (96.3%) underwent surgery, 184 (37.6%) by implantation of prostheses and 268 (54.7%) by osteosynthesis with intramedullary nails. The mean hospital stay was 10.1 ± 5.0 days.

Table 2 shows the results of the nutritional assessment. Ninety-nine (20.1%) patients had a BMI $<22\ \text{kg/m}^2$. Four hundred nine patients (81.2%) had protein malnutrition. Mixed malnutrition (low BMI and low serum protein) was present in 87 patients (17.1%) and 421 (83.5%) had one of each (low BMI or low serum protein).

Table 2. Nutritional parameters in the sample of patients admitted for hip fracture

	Valid cases	
Weight (kg)	493	61.9 (11.5)
Height (cm)	492	156.6 (8.9)
Body mass index (kg/m^2)	492	25.2 (4.3)
Body mass index <25 kg/m^2	492	260 (47.5%)
Body mass index <22 kg/m^2 [a]	492	99 (20.1%)
Albumin (g/dl)	503	3.1 (0.4)
Albumin <3.5 g/dl	503	405 (80.5%)
Total protein (g/dl)	509	6.8 (0.8)
Total protein <6.5 g/dl	509	141 (27.7%)
Protein <6.5 g/dl and/or albumin <3.5 g/dl[b]	509	409 (81.2%)
Mixed malnutrition (energy and protein) (both)	492	87 (17.1%)
Energy or protein malnutrition (any)	492	421 (83.5%)
Ferritin (ng/ml)	501	234.9 (234.9)
C-reactive protein (mg/l)	479	91.2 (59.7)
Vitamin D (ng/ml)	501	16.3 (12.5)
Vitamin D <20 ng/ml	501	380 (75.8%)
Vitamin D <30 ng/ml	501	466 (93%)
Parathyroid hormone (pg/ml)	501	75.2 (62.4)
Low skeletal muscle index	479	86 (18%)
Low grip strength	479	399 (91.1%)
Sarcopenia	479	82 (17.1%)

Data shown as mean (s.d.) or *n* (%). [a]Energy malnutrition. [b]Protein malnutrition. Valid cases: number of cases with valid data for each variable.

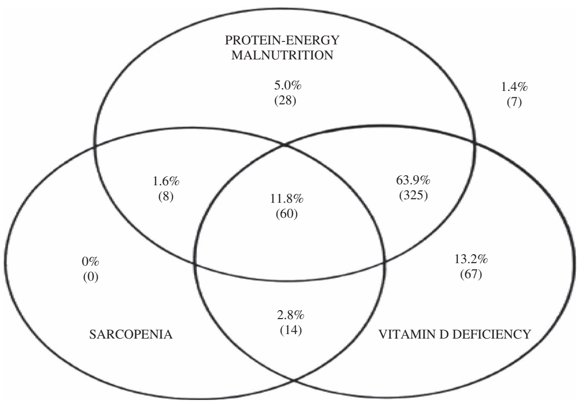

Figure 1. Venn diagram. Association between protein–energy malnutrition, sarcopenia and vitamin D in the 509 patients included. Data shown as % (*n*).

Four hundred sixty-six patients (93%) had vitamin D levels below 30 ng/ml and 380 patients (75.8%) had levels below 20 ng/ml.

Data on muscle mass and strength were collected in 479 cases, of which 82 (17.1%) were sarcopenic (had both low muscle mass and low muscle strength). The prevalence by sex was 12.4% in men and 18.3% in women.

The associations between the frequencies of the various deficiencies are shown in Figure 1. It is remarkable the frequent coexistence of several deficits occurs with protein–calorie malnutrition and vitamin D deficiency. Even 12% of subjects present together all the nutritional deficiencies studied. All patients with sarcopenia had at least one of the other deficiencies.

DISCUSSION

The results of this study, obtained from a broad cohort of acute HF patients representative of the HFs that occur over a year in a health-care area of 500 000 inhabitants, show that their malnutrition problems are common and more complex than is usually assumed. Specifically, protein malnutrition and vitamin D deficiency are almost the rule; energy and mixed malnutrition and sarcopenia are found in about one-fifth of cases.

Studies that we have found on malnutrition in HF patients published in the past 15 years show highly variable results. The variability between criteria and cutoff points used for the malnutrition assessment, as well as some differences between the series, such as mean age of the sample or percentage of cases that came from skilled nursing facilities, may have had an influence on the results. In general, the samples are small: only three included >400 patients.[30–32] Studies that use anthropometric criteria (primarily BMI and anthropometric measurements) show a prevalence of malnutrition between 5 and 52%.[11,12] Studies that use laboratory criteria (albumin in the majority of cases) show a prevalence of between 18 and 98%, although generally above 50%.[13,30] Our results are within the limits described and are very similar to those published in a series of 110 patients from the south of Spain by Montero *et al.*[9] that found a prevalence of energy malnutrition of 20.9%, protein malnutrition of 77.3% and mixed malnutrition of 13.7%. Other studies use the mini nutritional assessment questionnaire, obtaining a malnutrition risk prevalence of between 28 and 62%[14,20] and malnutrition between 9 and 28%,[13,31] with total figures between both groups generally above 50% and may be as high as 86%.[13]

The prevalence of vitamin D deficiency is notably high in HF patients in all countries, as was found in our series. Percentages of $>90\%$ of patients with plasma levels <30 ng/ml are usually reported and $>80\%$ of patients have levels <20 ng/ml.[18,19]

Among studies on sarcopenia in HF, one study that applied the EWGSOP criteria found a rate of 25% in the 3 months following the fracture.[33] The remaining studies we found did not apply the EWGSOP criteria, given that they only quantify muscle mass.[15–17] Three studies included patients in the first hours or days after the fracture. Two of them used DXA to measure low muscle mass. One of them found a prevalence of 47.4%,[15] whereas the other reported 16.4% in women and 70.6% in men.[17] One study using BIA found a rate of low muscle mass of 7%.[16] Overall, our results on low muscle mass (18%) are within the wide range of figures estimated to date.

Among the possible limitations of our study, we would like to mention the following. First, BMI is a parameter that is difficult to measure in bedridden patients. For this reason, although validated tables were used for the estimation, there may be greater errors than if current weight and height were measured.

Second, regarding the use of albumin as a nutritional assessment parameter, it is well known that said levels are influenced by the inflammatory state that comes with acute disease,[34] but it is also known that low albumin levels constitute a marker of poor prognosis in HF patients.[30,34] This is why it is usually included in the majority of studies that assess malnutrition in these patients.[6,8,9,13,30] In our study, the sample was generally collected within the first 24 h and always within the first 72 h, so it is hoped that the values were not greatly affected by the influence of the acute disease.

Another study limitation is related to the difficulty of assessing sarcopenia in acute HF patients. Gait speed cannot be assessed before surgery. Therefore, applying functional criteria is limited to measuring muscle strength. In addition, 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[28,35] but not all.[36,37] Nevertheless, other studies on sarcopenia in older individuals have been carried out using this technique even in HF patients and other acute patients, primarily as in our case because of its accessibility and ease of use for measuring without moving the patient.[15,38]

Finally, the recent consensus is to use malnutrition screening questionnaires such as the mini nutritional assessment, which is used in several studies published in the past 5 years.[13,14,31] It was not included in our study as it was considered to almost systematically classify the patients as at risk for malnutrition secondary to the presence of acute disease, surgical intervention, immobility and lack of appetite found in acute disease. On the other hand, the mini nutritional assessment is able to detect the presence of malnutrition but does not provide information on the type or existing deficiencies, meaning it does not orient towards individual nutritional needs.

The primary strengths of this study are the high number of cases included, greater than in other published series, and the lack of exclusion of any type of patient, which makes it representative of the entirety of the HF fractures that occur over a year in an area of 500 000 inhabitants. The majority of studies have small sample sizes and many also exclude patients who did not live at home,[30] had comorbidities[6,8,14,39] or had cognitive deterioration,[6,8,14,30,39] among other reasons.

Another strength is that a comprehensive assessment of nutritional status focused on the characteristic differences in HF patients was used. This considered the nutritional situation from a more complex perspective that has been the norm until now, given that it takes into account not only energy and protein malnutrition, but also the lack of vitamin D and sarcopenia.

In conclusion, malnutrition is common in acute HF patients and is also multifactorial. Protein malnutrition and vitamin D deficiency are the rule and energy malnutrition and sarcopenia are less common but affect a significant percentage of patients. Clinical management of these patients should integrate all of these conditions in order to correct them more effectively on a personalised basis. Subsequent studies that evaluate multimodal nutritional treatment will allow us to know if putting them into practice improves patient progress.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTIONS

JIG-M and TA designed and directed the FONDA cohort. MDB, TA and AO designed the methodology and carried out the statistical analysis. MDB, JIG-M, RM and RR performed the literature review update. MDB and JIG-M drafted the first version of the manuscript. All co-authors corrected the subsequent versions of the manuscript and approved the final version.

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