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Research paper

Grip strength and functional recovery after hip fracture: An observational study in elderly population

M. Neira Álvarez [a,*], P. López-Dóriga Bonnardeaux [b], I.J. Thuissard [c], D. Sanz-Rosa [d], E. Arias Muñana [e], R. Bielza Galindo [e], J.F. Gómez Cerezo [f]

[a] Department of Geriatrics, University Hospital Infanta Sofía, San Sebastián de Los Reyes, Paseo de Europa, 34, 28702 Madrid, Spain
[b] Unidad de Recuperación Funcional, Hospital de la Fuenfría, Cercedilla, Madrid, Spain
[c] Pharmacy and Biotechnology Department, School of Biomedical Sciences, Universidad Europea, Madrid, Spain
[d] Clinical Department, School of Biomedical Sciences, Universidad Europea, Madrid, Spain
[e] Department of Geriatrics, University Hospital Infanta Sofía. SS Reyes, Madrid, Spain
[f] Department of Internal Medicine and Geriatrics, University Hospital Infanta Sofía, SS Reyes, Madrid, Spain

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ABSTRACT

Introduction: Muscle strength is a common issue in fragility syndrome and sarcopenia, both of them involved in the pathogenesis of falls and fractures.
Objective: To study the relationship between hand grip strength and functional recovery after hip fracture surgery.
Methodology: This prospective observational study included patients aged 65 years and older who were admitted to hospital for hip fracture surgery during a 12 month period. Functional status (Barthel Index), mental status (Cruz Roja Index), hand grip strength, 25/OH-Vitamin D plasmatic levels were evaluated at admission. Follow-up was performed 3 months after discharge to assess functional status and survival. Correlations between hand grip strength and the rest of variables were evaluated. Univariate and multivariate analyses were further applied. Mean age of subjects was 85.1 ± 0.63 years. Out of 127 subjects, 103 were women and 24 were men. Hand grip strength was obtained in 85 patients (76.5%) and, values were between 3.3 and 24.8 kg and 81 patients (95.2%) had values below cut-point of sarcopenia considering European Working Group of Sarcopenia criteria. Hand grip strength at admission shows significant association to Barthel index at three months and functional recovery. It is also associated with age ($P < 0.001$) ($r = 0.81$), sex ($P = 0.001$), cognitive status by Cruz Roja Index ($P < 0.001$) and functional status measured at admission by Barthel Index ($P < 0.01$) ($r = -0.22$). Multivariate analysis confirmed that variables were independently associated to grip strength.
Conclusion: Hand grip strength measured at admission in Orthogeriatric Unit after hip fracture is directly related to functional recovery in elderly patients.

1. Introduction

Hip fracture is one of the most important health problems in the elderly population. It has a high incidence and prevalence [1] and severe consequences such as mortality (30% in the first year), high morbidity and functional disability, dependence and institutionalization. Thus, 10–20% of those living at home before hip fracture will be discharged to residential care and only a third will recover the previous functional status three months after hip fracture.

The economic impact of hip fractures is also an important fact and total cost has been estimated around € 9772 per patient in Spain [2].

Hip fractures in the elderly are usually a consequence of falls and these are related to many factors including cognitive impairment, psychotropic medication, postural hypotension or visual impairment. However, the interest is lately focused on frailty and sarcopenia as main contributors to falls. Frailty is a common geriatric syndrome that embodies an elevated risk of catastrophic declines in health and function among older adults [3]. It is a condition associated with ageing and is a result of loss of muscle mass, weakness, slowness, decreased energy, lower activity and unintended weight loss.

* Corresponding author. Tel.: +34 646 01 47 31.
E-mail address: marta.neira@salud.madrid.org (M. Neira Álvarez).

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Sarcopenia is characterized by loss of muscle mass associated to loss of muscle strength or physical performance [4]. Both entities contribute to adverse events as deaths, falls, hospitalization, loss of autonomy [3].

Sarcopenia and frailty syndrome often coexist and both have physical function impairment as a core component, which is one of the diagnostic criteria for both entities [3–5].

Epidemiological studies have shown that muscle strength measured in older people is a powerful predictor of functional decline, disability and mortality [6,7], but few studies have investigated this issue in the acute care setting.

Therefore it is possible that grip strength might be related to the physiopathology of hip fracture and predict functional recovery after hip fracture in the elderly.

Of course, there are other very good indicators of frailty and sarcopenia that are being used in clinical practice (gait speed, SPPB, BMI or other nutritional indicators) but hand grip strength is an easy feasible method to apply in hip fracture patients.

The aim of this study was to examine the relationship between hand grip strength and the functional status after surgery in older patients hospitalized with hip fracture. Similarly, the relationship between hand grip strength and functional and cognitive status soon after hip fracture, vitamin D levels and mortality during the first 3 months after surgery will be study.

2. Methods

The study was designed as a prospective, observational study to evaluate patients aged 65 years and older admitted to Hospital Infanta Sofia in San Sebastian de los Reyes (Madrid, Spain) over a 12-month period (from April 2014 to April 2015).

All of the participants or their legally authorized representatives gave informed consent and the study protocol was approved by the Biomedical Ethics Committee of the Infanta Sofia Hospital of San Sebastian de los Reyes (Madrid, Spain).

Patients, 65 years old or more, who were admitted to Infanta Sofia Hospital for surgery after hip fracture were included in the study. Those in which surgery treatment was rejected, patients with terminal disease and life expectancy less than three months or non osteoporotic fractures were excluded.

Data collected at time of admission included age and sex, type of fracture, functional status measured by the Barthel Index and cognitive status measured by the Cruz Roja Index.

Functional status was measured by the Barthel Index. Ten physical activities of daily living are evaluated in this index: eating, bathing, going to the bathroom, urinary continence and fecal continence, dressing, getting in and out of bed, walking and climbing stairs. The Barthel Index score ranges from 0 (total dependence) to 100 (total independence) [8].

Cognitive functioning was assessed using the Cruz Roja Index, a 6-point test of cognitive status in which lower scores indicate better status. It is widely used for the evaluation of cognition in elderly patients [9].

Hand grip strength was measured within the first 48 h after admission, using a standard adjustable handle dynamometer Kern & Sohn GmbH Balingen (Model; Elect WOC11007248). All measurements were performed with the dominant hand with a standard protocol and all patients were encouraged to exhibit the greatest possible force; the best recorded of three attempts was considered for the analysis.

Hand grip strength measurements less than 20 kg in women and 30 kg in men were considered cut-points for the diagnosis of sarcopenia as the Working Group of Sarcopenia of the European Geriatric Society recommends [4].

Additional information was serum 25-hydroxyvitamin D levels that were measured by competitive enzyme immunoassay technique (ADVIA Centaur, Siemens Healthcare Diagnostics). Blood samples were taken for 25-hydroxyvitamin D analysis within the first 72 h of admission.

Follow-up was performed 3 months after discharge to assess functional status by the Barthel Index and survival.

All statistical analysis were performed using IBM SPSS 21.0 (IBM Corp: USA). Sex, type of fracture, cognitive status (Cruz Roja Index) were presented as total figures and percentage. Date of age, functional status (Barthel Index), hand grip strength and vitamin D levels were presented as means ± standard deviation.

The principal outcome was hand grip strength. Functional recovery was defined as the difference between Barthel Index at admission and three months later and it was considered a quantitative variable.

Correlations between hand grip strength and the rest of variables were evaluated using the Rho Spearman correlation. Univariate and multivariate analyses were further applied to investigate which of the significant components were truly independent factors related to hand grip strength. A P-value < 0.05 was considered to be significant in all tests made.

3. Results

In total, 127 consecutive patients with hip fracture over the age of 65 were evaluated; 24 patients were men (18.9%) and 103 were women (81.1%). Mean age was 85.1 ± 0.63 years, being women older than men (85.8 ± 0.6) vs. (82.0 ± 1.7 years; $P = 0.017$).

Seventy patients had a pertrocantheric hip fracture (55.0%), 49 had a neck fracture (38.6%) and 8 had a subtrocantheric fracture (6.3%).

Regarding cognitive status, 58 patients (45.7%) showed cognitive impairment (Cruz Roja Index score ≥ 2). Characteristics of the sample are described in Table 1.

Hand grip strength was measured in 85 patients (76.5%); the rest of participants were unable to performance the test, because of cognitive disability or acute clinical illness.

When hand grip strength was obtained, values were between 3.3 and 22 kg in women and 6.5 and 24.8 kg in men. Eighty-one patients (95.2%) had values below cut-point for the diagnosis of sarcopenia as the Working Group of Sarcopenia of the European Geriatric Society recommends.

In relation to the main objective, which is to analyze the functional status and functional recovery at the third month, hand grip strength at admission showed a significant association with Barthel index at three months (Fig. 1) and also with functional recovery (Fig. 2).

Hand grip strength was associated with age ($P < 0.001$) ($r = 0.81$), sex ($P = 0.001$), cognitive status measured by the Cruz Roja Index ($P < 0.001$) and functional status at admission

Table 1
Clinical characteristics of the sample (no. = 127). Descriptive analysis[a].

Age (yr)	85.10 ± 0.63
Female sex–no. (%)	24 (18.9)
Vitamin D (25-OH)-ng/ml	26.59 ± 1.82
Hip fracture type no. (%):	
Pertrochanteric fracture	70 (55)
Femoral neck fracture	49 (38.6)
Subtrocantheric fracture	8 (6.3)
Cognitive status (Cruz Roja Index[b])	1.57 ± 0.14
Barthel Index at admission	67.13 ± 2.69
Barthel Index at three months[c]	49.48 ± 3.19
Hand grip strength[d] (kg)	10.33 ± 0.53

[a] Data are shown as means ± SD or frequencies.
[b] Cruz Roja Index ranges from 0 (best) to 5 (worst).
[c] Barthel Index at three months was measured in a total of 106 patients. Scores on the Barthel Index range from 0 (worst) to 100 (best).
[d] Hand grip strength was measured in a total of 85 patients.