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SHORT COMMUNICATION

Usefulness of a national hip fracture registry to evaluate the profile of patients in whom antiosteoporotic treatment is prescribed following hospital discharge

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Abstract

Summary This study was carried out to describe the profile of prescription of antiosteoporotic treatment at discharge after a hip fracture in the Spanish National Hip Fracture Registry. Prescription rates among hospitals ranged from 0 to 94% of patients discharged. The prescription rate was higher among patients with better cognitive and functional baseline status.

Purpose National hip fracture registries are useful for assessing current care processes. The goals of this study were as follows: first, to know the rate of antiosteoporotic prescription at discharge among hip fracture patients in hospitals participating in the Spanish National Hip Fracture Registry (RNFC); second, to compare the differences between treated and non-treated patients; third, to analyze patients' characteristics associated with antiosteoporotic prescription at discharge; and fourth, to evaluate whether there were differences in the profile of patients discharged from hospitals with high and low prescription rates.

Method Patients discharged after a fragility hip fracture in 2017 and participating in the RNFC were included. Demographic variables, cognitive and functional status, prefracture osteoporosis treatment, fracture type, anesthetic risk, hospital volume, and antiosteoporotic prescription at discharge were analyzed. Given that patients were clustered within hospitals, intraclass correlation was calculated and generalized estimating equations were fitted.

Results A total of 6701 patients from 54 hospitals were included. Antiosteoporotic prescription at discharge was prescribed to 36.5% (CI95% 35.8–37.2%), with a wide inter-hospital variability (range 0–94%). The intraclass correlation due of clustering of patients within hospitals was 47.9%. Antiosteoporotic prescription was more likely in patients who were younger, lived at home, previously treated for osteoporosis, had better baseline functional and cognitive status, lower anesthetic risk, and were discharged from high-volume hospitals, all with $p < 0.001$. The general profile of patients discharged from hospitals with high and low rate of prescription was similar.

Conclusions There is a wide variability between hospitals regarding antiosteoporotic prescription after hip fracture. This is more likely to be initiated in patients with better clinical, functional, and mental status and in those discharged from hospitals with larger volumes of patients. These results offer insights regarding the selection of patients receiving secondary prevention and raises questions on who and how many should be treated.

Keywords Hip fracture · Registry · Audit · Antiosteoporotic treatment

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Introduction

Hip fracture registries are a useful tool for studying the current care process, revealing strengths and weaknesses in these processes and helping to detect flaws, the correction of which would lead to improvement of care. Another of its uses is to evaluate existing clinical variability, in order to reduce it and thus improve results and reduce costs [1].

The Spanish National Hip Fracture Registry (RNFC) (Registro Nacional de Fracturas de Cadera, RNFC, in Spanish) was launched in 2016. It includes patients aged 75 years and

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above admitted for a fragility hip fracture. It includes the audit during acute hospitalization and a 30-day follow-up [2].

One particularly relevant aspect of the hip fracture care process is secondary prevention of future fractures. In this regard, the two recommended measures are prevention of new falls and treatment of osteoporosis [3]. The risk of new fractures is much higher after a hip fracture, which is why treatment, if initiated, should be started as soon as possible. It is even recommended to start the treatment at discharge from the acute orthopedic unit [4, 5].

Comparison of published national registries shows a large variability in the rate of antiosteoporotic drugs prescription at discharge among different countries, and there is also a wide variability of prescription rates inside each country [6–8].

This study had several goals: first, to calculate the rate of antiosteoporotic prescription at discharge among hip fracture patients in the hospitals participating in the RNFC; second, to compare the differences in the profile of treated and non-treated patients; third, to analyze patients' characteristics associated with antiosteoporotic prescription at discharge; and fourth, to evaluate whether there were differences in the profiles of patients discharged from hospitals with high and low prescription rates.

Material and method

The RNFC is a continuous registry of patients admitted for a hip fracture in a large group of Spanish hospitals, with 54 hospitals participating in 2017, most of them included in the National Health Service Network. It represents 71% of all regions nationally. Hospitals participate voluntarily, and its structure and operation has previously been described [2]. Data collection is performed following the Spanish translation of the Minimum Common Dataset (MCD) proposed by the Fragility Fracture Network (FFN), which shares three important features: It is concise, it covers the key elements that define the casemix, and it is compatible with existing audit databases. The physician in charge of the patient collects data during acute hospitalization (baseline situation and those relative to the care process until discharge), and follow-up is performed 1 month after the fracture through a telephone interview or during the follow-up visit, by the healthcare professional in charge. A data manager collects the data from all the hospitals, performs data cleansing, descriptive summaries, analyzes the pertinent associations, and elaborates periodic reports.

For this analysis, we included all the patients aged 75 years and above admitted for a fragility hip fracture discharged from the participating hospitals registered between January 1 and October 31, 2017, period included in the 2017 Annual Report from the Registry (English version available at http://rnfc.es/) [9].

The variables included were age, gender, pre-fracture place of residence, baseline walking ability and cognitive status, type of fracture, anesthetic risk, and prescription of antiosteoporotic treatment prior to the fracture and at discharge.

Prior independent mobility was defined if the patient had been able to ambulate without the assistance of another person, at least inside the usual place of residence. Cognitive impairment was considered absent if the patient scored less than 4 errors in Pfeiffer's Short Portable Mental State Questionnaire (SPMSQ) [10]. This cut-off is appropriate, according to the validated Spanish version [11]. Fractures were classified as intracapsular, intertrochanteric, and subtrochanteric. A score of less than III in the American Society of Anesthesiologists Scale (ASA) [12] was considered a low anesthetic risk. Prescription of antiosteoporotic treatment, prior to the hip fracture as well as at discharge, was defined as receiving antiresorptive or bone-forming medications.

Hospitals were divided in high and low rate of prescription if they were above or below the mean overall prescription rate. Regarding the number of patients registered by each hospital, we defined those that registered a number equal or above the median as high-volume hospitals and the rest low-volume hospitals.

To calculate the rate of antiosteoporotic prescription at discharge, statistical analysis was performed calculating the percentage of patients with that treatment among the total of registered patients and its confidence interval (CI 95%). A descriptive analysis of the different variables included was performed. To evaluate the differences between patients with and without antiosteoporotic prescription at discharge, two-sample non-parametric comparisons were performed using the Mann–Whitney test for continuous variables and the Chi-square test (or Fisher's exact test) for categorical variables, in both cases.

Given that patients were clustered within hospitals, the intraclass correlation (ICC) was calculated as ICC=VA/VA+3.29 [13], where VA is the hospital residual variance expressed on the logistic scale, estimated in a multilevel logistic model including only the random-intercept and no covariates (empty model). Since our aim was to examine the associations between patient characteristics and antiosteoporotic treatment, generalized estimating equations (GEE) were fitted taking into account the clustering effect and using an unstructured variance-covariance matrix.

For this study, cases with less than 1.5% of missing data were included; the variables antiosteoporotic prescription at discharge, age, sex, and type of fracture had to contain 100% of data. The only exception to this rule was for the variable "cognitive status," in which absence of data was above 1.5%, but considering that this could be due to the patient's clinical situation, it was converted into a dummy variable. Data was analyzed using SPSS v24 and Mplus v8.

Results

A total of 6814 patients were discharged from the 54 hospitals participating in the RNFC during the period analyzed. A total of 6701 patients were included in the study. The median number of cases registered per hospital was 97 cases (interquartile range 43–177).

At discharge, antiosteoporotic medication was prescribed to 2449 patients or 36.5% (CI95% 35.8–37.2). Prescription rates among the 54 hospitals ranged between 0 and 94% of patients.

Table 1 shows the characteristics of patients, classified according to antiosteoporotic prescription at discharge (univariate analysis), were younger, more commonly female and community dwelling, were more frequently on antiosteoporotic treatment before the fracture, had better pre-fracture functional and cognitive status, a lower anesthetic risk, and were more frequently discharged from high-volume hospitals.

Intraclass correlation shows a clustering effect of patients within hospitals (ICC = 46%; Variance = 3.18), indicating that the probability that a patient receives an antiosteoporotic treatment prescription depends on the hospital. The GEE estimated coefficients showed that younger age, living at home, independent mobility, a normal cognitive status, low anesthetic risk, taking antiosteoporotic medication before the fracture, and being discharged from a high-volume hospitals were independently associated with antiosteoporotic prescription at discharge (Table 2).

There were no differences in the patients' baseline characteristic when comparing those discharged from high versus low rate of prescription hospitals, except for slightly higher rates of osteoprotective pre-fracture treatment and cognitive impairment in high rate of prescription hospitals (Table 3).

Discussion

This study analyzes the prescription rate of antiosteoporotic treatment following hip fracture in a national registry, and the factors associated with prescription at discharge from acute hospitalization. The average prescription rate was barely over one third of patients, and a large variability was seen between hospitals. In the spite of the influence of the hospital where the patient was treated (cluster effect), there was a tendency to prescribe more treatments among patients that had better walking ability and cognitive function, and had a better clinical situation. Finally, patients treated at high-volume hospitals were more likely to receive treatment for osteoporosis at discharge.

Prescription rate and variability

The percentage of patients discharged after a hip fracture in the Spanish hospitals participating in the RNFC and with antiosteoporotic prescription at discharge was low (36.5%), but mid-range compared to other international registries. It

Table 1 Characteristics of 6701 patients, included in the study, discharged from 54 hospitals participating in the Spanish National Hip Fracture Registry in 2017, classified according to antiosteoporotic (antiresorptive or bone-forming) prescription at discharge

Variables		*Treated*	*Not treated*	
BASELINE	*n* = 6701	*n* = 2449	*n* = 4252	*p*
Age (years), mean (SD)	86.5 (5.5)	85.7 (5.2)	87 (5.6)	< 0.001
Age (years), n (%)				< 0.001
75–84	2407 (35.9)	1014 (41.4)	1393 (32.8)	
85–94	3796 (56.6)	1314 (53.7)	2482 (58.4)	
> 94	498 (7.4)	121 (4.9)	377 (8.9)	
Gender (female), n (%)	5116 (76.3)	1907 (77.9)	3209 (75.5)	0.020
Pre-fracture living at home, n (%)	5079 (76.2)	2008 (82.3)	3071 (72.7)	< 0.001
Pre-fracture antiosteoporotic treatment, n (%)	344 (5.1)	267 (10.9)	77 (1.8)	< 0.001
Pre-fracture independent mobility, n (%)	5497 (83.2)	2172 (89.3)	3325 (79.6)	< 0.001
Cognitive status, n (%)				< 0.001
No impairment	3126 (46.6)	1336 (54.6)	1790 (42.1)	
Impairment	2404 (35.9)	760 (31.0)	1644 (38.7)	
Without data	1171 (17.5)	353 (14.4)	818 (19.2)	
Type of fracture, n (%)				0.630
Intracapsular	2661 (39.9)	971 (39.9)	1690 (39.9)	
Intertrochanteric	3493 (52.4)	1285 (52,8)	2208 (52.1)	
Subtrochanteric	517 (7.7)	179 (7.4)	338 (8.0)	
ASA < III, n (%)	1882 (28.1)	779 (33.1)	1103 (27.5)	< 0.001
Admitted to hospitals with ≥ median cases/year, n (%)	5420 (80.9)	2184 (89.2)	3236 (76.1)	< 0.001

ASA, American Society of Anesthesiologists

Table 2 Factors independently associated with antiosteoporotic (antiresorptive or bone-forming) treatment at discharge in the patients discharged ($n = 6701$) from 54 hospitals participating in the Spanish National Hip Fracture Registry in 2017. Generalized estimating equations

	B	Std. Error	*p*	OR	CI95%
Age					
75–84 years	0.631	0.121	< 0.001	1.98	1.50–2.40
85–94 years	0.389	0.118	0.001	1.50	1.19–1.88
(ref > 94 years of age)					
Pre-fracture living	0.300	0.072	< 0.001	1.36	1.18–1.57
(ref in nursing home)					
Pre-fracture mobility	0.468	0.086	< 0.001	1.60	1.35–1.89
(ref dependent)					
Cognitive status					
No impairment	0.195	0.066	0.003	1.22	1.08–1.39
Without data	0.042	0.084	0.620	0.99	0.84–1.17
(ref cognitive impairment)					
Anesthetic risk (ASA)	0.163	0.061	0.008	1.17	1.04–1.32
(ref ASA > II)					
Hospital with ≥ median cases/year	0.975	0.813	< 0.001	1.74	1.57–1.97
(ref ≥ 98 cases/year)					
Pre-fracture osteoprotective treatment	1.991	0.145	< 0.001	7.12	5.38–9.42
(ref no)					
Gender	0.066	0.062	0.31	1.07	0.94–1.22
(ref male)					

ASA, American Society of Anesthesiologists

was lower than the rates reported by registries such as England, Northern Ireland and Wales (58%) [14], Ireland (57%)[6], Denmark (50%) [7], and South Korea (39%) [15], but higher than those reported in other registries such as New Zealand (31%) [8], Italy (30%) [16], the Netherlands (29%) [17], Australia (16%) [8], the United States (14%) [18], and Germany (10%) [19].

The wide variability of antiosteoporotic prescription at discharge rates has also been described in the Danish Hip Fracture Registry (14–100%) [7], the Irish Hip Fracture Database (17–85%) [6], and the Australia and New Zealand Hip Fracture Registry (rates of 0–70% and 0–48% for Australia and New Zealand, respectively) [8]. There is also a large variability in other indicators such as length of stay [20].

Table 3 Characteristics of the patients included in the Spanish National Hip Fracture Registry, comparing patients discharged from hospitals with high and low prescription rates (above or below, 36.5%, the overall mean percentage of antiosteoporotic treatment at discharge) ($n = 6701$)

	Patients from hospitals with high prescription rates $n = 2613$	Patients from hospitals with low prescription rates $n = 4088$	*p*
Age (years), mean (SD)	86.4 (5.7)	86.7 (5.5)	0.031
Women, n (%)	2004 (76.7)	3112 (76.1)	0.596
Prefracture living at home, n (%)	1996 (76.8)	3083 (75.9)	0.409
Prefracture antiosteoporotic treatment, n (%)	174 (6.7)	170 (4.2)	< 0.001
Prefracture independent mobility, n (%)	2158 (83.5)	3339 (82.9)	0.545
Cognitive status, n (%)			0.015
No impairment	1260 (48.2)	1866 (45.7)	
Impairment	882 (33.8)	1522 (37.2)	
Without data	471 (18.0)	700 (17.1)	
Type of fracture, n (%)			0.228
Intracapsular	1062 (40.9)	1599 (39.2)	
Intertrochanteric	1346 (51.9)	2147 (52.7)	
Subtrochanteric	187 (7.2)	330 (8.1)	
(ASA < III), n (%)	754 (28.9)	1128 (29.2)	0.482

ASA, American Society of Anesthesiologists

Profile of patients with antiosteoporotic treatment

Results of the effects of patient variables on the final mixed effects model show the association with the variable antiosteoporotic treatment at discharge, corrected by the hospital clustering effect. The characteristics of treated patients defines a group of older patients with better functional and vital prognosis, and all hospitals seem to agree with this profile, albeit with large variations regarding the percentage of patients treated at each hospital. Considering that antiosteoporotic treatment requires a few months to be effective, that it is a chronic treatment, that it is indicated after an osteoporotic fracture, and that it is cost-efficient, it seems logical to initiate therapy at least among the elderly with the best clinical and functional prognosis, as well as the greatest life expectancy. On the other hand, treatment may be futile for patients without a chance of regaining walking ability or with a limited life expectancy [21]. In the RNFC, 95% of patients are evaluated by a clinical specialist during acute hospitalization, mostly geriatricians, who apparently take the patient's baseline status and prognosis into account before initiating treatment.

Hospital case volume and prescription of antiosteoporotic treatment

The fact that there is such a wide variability of antiosteoporotic prescription at discharge among hospitals, while the case mix is similar, is striking. There were small differences regarding the presence of cognitive impairment, but we did not find them clinically relevant. However, the amount of patients treated yearly for hip fracture at a given hospital was much more significant. Physicians at hospitals treating lower annual case-volumes were less likely to prescribe antiosteoporotic treatment at discharge. There could perhaps be a lack of awareness for secondary prevention if hip fractures are not a common entity treated by these clinicians. On the other hand, it is possible that high-volume hospitals are more likely to be academic centers with established fracture liaison services, increasing the likelihood of treatment at discharge. Further analyses are planned in this direction.

Patient characteristics depending on hospital rate of prescription

The patients' characteristics were similar for hospitals with high and low prescription rates. Thus, differences found in antiosteoporotic prescription at discharge cannot be attributed to differences in the baseline profiles of patients treated in these hospitals.

From the observed results, the following thoughts arise:

(1) Based on the available medical evidence, and in light of the low overall rate of antiosteoporotic prescription at discharge following hip fracture, the percentage of patients treated for osteoporosis after hip fracture should increase.

(2) Since there seems to be a profile of patients who are better candidates for being treated, i.e., those with a better clinical, functional, and mental status, and since the characteristics of patients treated for hip fracture do not differ much among hospitals, the antiosteoporotic prescription at discharge rate should improve for at least this group of patients, reducing clinical variability among hospitals. At the other end of the spectrum, there seems to be a group of patients in whom initiation of antiosteoporotic treatment is not considered appropriate. Patients were assessed, but no bone protection medication was considered necessary or appropriate, in 21.6% reported by the British National Hip Fracture Database [14], 16–38% in the Dutch Hip Fracture Audit [17], 6% in the Irish Hip Fracture Database [6], and 28.7% in the United States [18].

(3) We can take a further step and reflect on the benefit of bone protection medication in patients with a worse baseline status, as well. Several papers suggest a higher imminent fracture risk in patients with a recent fracture and with functional and cognitive impairment [3, 22], and treatment can be more efficient for precisely these patients [3], due to this higher risk.

To the best of our knowledge, this is the first time the profiles of patients in whom rates of antiosteoporotic prescription at discharge following a hip fracture are analyzed in detail in a national registry. A database study using primary care data from the United Kingdom showed a high variability of antiosteoporosis drug prescription in the months following a hip fracture, varying from 34 to 50% among regions [23]. Several questions remain to be answered: What is the optimum percentage of patients to receive bone protection medication after a hip fracture? Which patients would not benefit from treatment, and what are their characteristics? As with other diseases, there is a lack of clinical trials assessing the treatment benefit for patients belonging to the age group at which hip fractures occur most commonly [24]. Given this lack of data, patient audits can be a very useful tool to study the situation and evaluate treatment utility, for example by prolonging follow-up time.

Our study has several limitations. First, it has the limitations inherent to registry data, in which issues such as comorbidity or specific fracture risk assessment such as FRAX® were not performed. Some of these aspects are likely to affect the prescription of bone protection medication to the individual patient, but we believe this would not justify the variability in prescription rates, as the casemix between hospitals was found to be similar. Second, we are unable to guarantee that all hospitals in Spain would have the same results. For this, a study analyzing national representativeness of the RNFC is currently underway, comparing its data with the automated national Minimum Data Set of the Ministry of Health. Third,

we did not assess the effect of structured Fracture Liaison Services (FLS) on prescription rates; we did observe that high-volume hospitals were more likely to prescribe antiosteoporotic medication at discharge, and it is possible that these hospitals are academic centers with established FLS. Further studies analyzing this question are planned. Finally, treatment persistence and refracture rates would be interesting to study, but are currently not possible using the available data; a study addressing these aspects with a longer follow-up in a subset of patients is underway.

In conclusion, analysis of registry data shows a wide variability between the participating hospitals regarding initiation of antiosteoporotic prescription at discharge after hip fracture. Treatment is more likely to be started among patients with a better clinical functional and mental status, admitted to hospitals treating larger volumes of hip fracture patients annually. These results provide food for thought for all professionals involved in treating patients with hip fracture: Are we treating the right amount and type of patients? This question needs to be answered rather sooner than later.

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Compliance with ethical standards

Conflict of interest The following authors have no conflicts of interest to declare: Alarcon T, Gómez-Campelo P, Navarro-Castellanos L, and Otero-Puime A.

The following authors declare:

Ojeda-Thies C has received honoraria for speaking at symposia from Amgen and financial support for attending symposia from Amgen and UCB Pharma; none of them related with the present work. Sáez-López P has received honoraria for speaking at symposia and financial support for attending symposia from Abbott, Nestlé and Amgen; none of them related with the present work. González-Montalvo JI has received research grants from Nestlé Health Science and Abbott Nutrition, has received speaker honoraria from Nutricia, Nestlé Health Science, Amgen, and Abbott Nutrition, and has received financial support for educational programs from Nutricia and Amgen; none of them related with the present work.

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