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ORIGINAL ARTICLE

Hip fractures in Spain: are we on the right track? Statistically significant differences in hip fracture management between Autonomous Communities in Spain

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Abstract

Summary Although medicine is currently protocol-based, there are still differences in the management of the hip fracture in Spain, especially regarding surgical delay, type of anesthesia, early mobilization, and discharge destinations. This data will be of great value to assist stakeholders in formulating health policies.

Purpose Analysis of demographic, clinical, surgical, and functional data of the Spanish National Hip Fracture National Registry (RNFC), during admission and at 1-month follow-up, by Autonomous Communities (ACs).

Methods Cross-sectional analysis in the framework of a RNFC cohort, from January 2017 to May 2018, including 15 ACs from Spain, with 1 month of follow-up. Sociodemographic, clinical, surgical, and outcome variables were analyzed.

Results In total, 13,839 patients were analyzed. There were significant differences (p <0.001) in median surgical delay and percentage of patients operated in less than 48 h. Mean surgical delay was 70.75 h, with a 12-h difference between the Communities of Madrid (71.22) and Catalonia (59.65). Only 43% of patients had less than 48-h delay. Overall, most patients received regional anesthesia (91.9%); however, there was a significant difference between ACs (p = 0.0001). There were also differences in inpatient stay, early mobilization, discharge destination, and mortality (p <0.001). Mortality 30 days after surgery was 7.8%, and highest in the Basque Country (12.5%).

Conclusions The registry showed homogeneity among ACs regarding sociodemographic variables, fracture type, surgical treatment, ASA risk, and co-management with a geriatrician or an integrated internist. There were significant differences in hip fracture management between ACs in Spain, especially regarding surgical delay, type of anesthesia, early mobilization, and discharge destinations.

Keywords Hip fracture · Hip fracture registry · Outcomes · Mortality · Variability of care

Introduction

Hip fractures (HF) are injuries often resulting in long-term disability that can also lead to premature death in elderly people [1]. Due to their high incidence and the rapidly growing elderly population, these fractures are one of the most challenging and fastest growing public health concerns [2]. In Europe, HF account for a greater loss of years due to

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disability than most cancers [3]. Moreover, the stress of suffering a hip fracture not only affects the patient but also their family and caregivers [4].

According to statistical data from the Health Spanish Ministry, the incidence is approximately 40,000 to 45,000 hip fractures per year, the care of which involves an annual cost of 1.591 million euros and a loss of 7218 quality-adjusted life-years [5–7]. Moreover, the incidence is expected to continue to increase in the near future [7]. For these reasons, adequate estimation of the epidemiological framework of fragility hip fractures in Spain and their impact on the elderly population is essential.

National registries have been set up for patients with HF in several countries. The National Hip Fracture Database (NHFD) in England, which is the largest one, the Australian and New Zealand Hip Fracture Registry (ANZHFR), or the Swedish National Hip Fracture Registry (RIKSHÖFT) are some of the most relevant audits [8–11]. These and others have been summarized in recent publications, observing that in the countries with established HF registries, the care process has been audited as a result, analyzing adherence or deviance from established quality standards and introducing corrective measures to improve the care process and efficiency [6, 8, 12]. In Spain, some registries and multicentric studies have been undertaken previously [3, 13–15]. A registry in the community of Castile and León including 776 hips fractures was published [15]. Also, a registry of 3995 hip fractures was conducted in the Community of Madrid [13]. Caeiro et al. recently published a multicentric study that included 487 consecutive patients with HF admitted to 28 hospitals in 6 Autonomous Communities (ACs) in Spain. The multicenter study SPARE-HIP comprised cohorts of 30 cases of hip fracture each from 45 Spanish hospitals (997 patients with HF) [3, 14]. In spite of the great interest of these studies, they were not sufficient to obtain a sample ensuring epidemiological representativeness on a national level, with the ideal aim of including all patients with HF hospitalized in the country. A difficulty in Spain is that the 17 ACs have different healthcare systems, with autonomy for their organization. This hinders unified implementation of measures and affects obtaining homogeneous results. This fact also complicates the establishment of a national project like the RNFC; however, the voluntary effort of professionals caring for patients with osteoporotic hip fracture and their desire to improve quality of care made the RNFC possible.

Spain is currently expected to be the country with the most forecasted life expectancy, exceeding 85 years for both sexes by 2040 [16]. In this setting, improving hip fracture care is increasingly important. The main objective of this study is to ascertain the demographic, clinical, surgical, functional, and care-based characteristics of patients with hip fractures throughout the Spanish territory, during hospitalization and at 1-month follow-up, by Autonomous Communities (ACs).

Methods

We conducted a multicentric, prospective cohort study including 61 hospitals in the National Health Service network from 15 of the 17 Spanish ACs. The 61 hospitals included are hospitals with different levels of complexity of care. Hospitals were invited to participate in the national hip fracture registry (RNFC) if they treated elderly patients with hip fracture. The inclusion criteria were as follows: (1) patients who had been admitted to one of the participating hospitals with the diagnosis of fragility hip fracture (due to a fall from standing height). (2) Aged older than 74 years (75 years or older). (3) Provision of informed consent for participation (by the patient or their next of kin). All consecutive cases meeting the inclusion criteria in participating hospitals were included.

The variables collected were as follows: Autonomous Community (AC), age, gender, the anesthetic risk (American Anesthesiologists Society Score (ASA)), the type of hip fracture, the type of surgical intervention performed, the type of anesthesia used during surgery, the involvement of a clinical physician in addition to a specialist in Orthopaedic Surgery and Traumatology, surgical delay, inpatient stay, the early postoperative mobilization (in the first 24 h after the intervention), and destination of discharge, mortality, and surgical readmissions and surgical re-interventions in the month following the fracture. All patients were followed up for up to 30 days after their index admission date.

Data were collected using the Spanish version of the Fragility Fracture Network registry (FFN Minimum Common Dataset—MCD). Data collection took place in 2 phases. In the hospital phase, the physician in charge of the patient collected data corresponding to baseline status and those referring to the process until the time of discharge. In the post-discharge phase, patients were followed up by visitation in the outpatient clinic or by telephone interview by the treating clinician who also registered the data, as described by Sáez-López et al. [7]. There was a representative in each participating hospital as the local person in charge of the registry, responsible for safeguarding and sending data. The data sent was encrypted and entered into an online platform for analysis. A data manager was in charge of the analyses.

Statistical methods

A general descriptive analysis was carried out, as well as by ACs, with measures of central tendency for the quantitative variables. If the variables followed a normal distribution, means and standard deviations were used; otherwise, the medians and ranges were used. Absolute frequencies and percentage were used for categorical variables. To compare different ACs, an analysis of the variance was made with the variables of interest and graphs created using the STATA

software statistical package (version 14.2; STATA Corporation, College Station, TX, USA).

Results

Between January 2017 and May 2018, the RNFC collected data from 13,839 patients from 61 hospitals (List of participating hospitals of the Spanish RNFC, Supplementary Material). About 79% of the patients recruited are from 5 ACs (Community of Madrid, Catalonia, Castile and León, Castile-La Mancha, and Aragon). Baseline demographic characteristics of the study population are reported in Table 1. Table 2 describes the differences between ACs. Mean ages of the patients were 86.7 years (SD 5.6), with variations between ACs ($p < 0.001$). Women comprised 75.8% of patients with hip fractures. This proportion was smaller in the Valencian Community (70.4%), while women were more than 80% of patients treated in the Principality of Asturias and in the Balearic Islands.

Most patients nationwide had an ASA 3 risk score (59%). Andalusia had the highest percentage of ASA 3 patients (80.5%), followed by the Principality of Asturias (74%). The Valencian Community was the only one in which ASA 2 patients were the largest group (54%). The distribution of hip fracture types, extracapsular vs. intracapsular, showed little variation between communities. Extracapsular fractures were the most common type of hip fracture (59.7%). Treatment type was closely related to the types of fracture; nationwide, 57.1% of fractures were treated with intramedullary nails and 33.3% were treated with arthroplasty. Overall, most patients received regional anesthesia (91.9%) ($p = 0.0001$). More than 10% of patients received general anesthesia in only three ACs, Navarre, Catalonia, and the Basque Country (14.0%, 14.7%, and 31.4%, respectively). 96.7% of hospitals participating in the RNFC had either a geriatrician or an integrated medical specialist (internist or other).

Mean surgical delay was 70.75 h; if we use the median to limit the impact of extreme values, the surgical delay was 57.5 h. A large variability was observed among the different ACs ($p < 0.001$) (Fig. 1). Among the 5 ACs providing the most patients, there was 27-h difference in delay between Aragon (45.2 h) and Castile and León (72.2 h). Only 43% of patients were operated in less than 48 h overall ($p < 0.001$). Of the 5 ACs providing the most patients to the RNFC, only Aragon operated more than 50% of patients in the first 48 h after admission. Other ACs studied that operated more than 50% of patients in less than 48 h were Andalusia (67.1%), Balearic Islands (80%), Extremadura (51.4%), and the Valencian Community (63.4%). Median length of stay was 9 days; among the 5 ACs providing the most patients to the registry, the largest in-hospital stay was in the Community of Madrid (9.7 days) and the lowest in Aragón (7.4 days). When including all ACs, the Balearic Islands and Canary Islands were the extremes of the acute length of stay, longest in the Canary Islands (16.8) and shortest in the Balearic Islands (3.8 days) ($p < 0.001$) (Fig. 2). 61.8% of patients were mobilized in the first 24 h. However, there was a great variability between the ACs ($p < 0.001$) (Fig. 3). In example, Catalonia and the Community of Madrid, the two ACs with the largest number of patients recruited, differed almost 30 percentage points in early mobilization; patients in Catalonia were mobilized on the first postoperative day in 35.7%, compared to 63.5% of the patients treated in Community of Madrid.

In-hospital mortality was 4.4%. The proportion of patients who died after surgery was higher than that of patients who died before the intervention. The highest in-hospital mortality was observed in the Basque Country (8.4%) (Fig. 4). Mortality at 30 days was 7.9% overall, being the highest in the Basque Country (12.5%) and the lowest in the Balearic Islands, the Region of Murcia and the Canary Islands (<3%). A large variability in in-hospital mortality and 30-day mortality was observed between the ACs ($p < 0.001$). At discharge, only 38.3% of the patients returned home, with great variability between ACs ($p < 0.001$). In Andalusia, the Balearic Islands, the Canary Islands, Galicia, the Region of Murcia, and the Valencian Community, more than 70% of patients returned home, while in the rest of Spain, especially in Castile-La Mancha, Castile and León, Catalonia, and the Community of Madrid, less than 40% of patients returned home. Finally, 2.7% of patients had surgical readmissions at 30 days. While it reached 8.8% Extremadura, the value remained homogeneous in the rest of the Autonomous Communities ($p < 0.001$). We also found a 1.9% reoperation rate (Table 1).

Discussion

Because osteoporotic hip fractures are among the most challenging and fastest growing public health concerns, clinical guidelines and protocols have been developed to improve hip fracture care [2, 8–11]. The Ministry of Health has a series of common indicators of quality of care, among them surgical delay of less than 48 h. Each ACs can incentivize different priorities, depending on their regional idiosyncrasy, and some ACs have orthogeriatric co-management as a standard of care, while others do not [17]. Initiatives such as National Hip Fractures Registries have also affected the outcome of patients with hip fractures favorably [8–11]. There has been previous experience with osteoporotic hip fracture registries in some ACs such as the Community of Madrid and Castile and León [12, 14, 15]. To our knowledge, this study is the first including a large number of cases from practically all of the ACs (13,839 patients and 15 of 17 ACs), allowing for analysis of the variability in the care provided in the different regions of Spain. The most important finding is that there are significant differences in the management of the hip fractures among ACs in Spain, especially regarding surgical delay, type of anesthesia, early mobilization, and discharge destination. Furthermore, the availability of downstream geriatric

Table 1 Description of general characteristics of the study participants

Variable	Value (total number)
Gender—percentage	
Male	24.2 (3 340)
Female	75.8 (10 476)
Age—mean (SD)	86.7 (5.6)
Surgical delay—median (range)	57.5 (0–907.5)
Surgical delay less than 48 h—percentage	
Yes	43.3 (5 724)
No	56.7 (7 504)
Inpatient stay—median (range)	9.0 (0.06–124.74)
ASA scale—percentage	
1	1.3 (175)
2	27.6 (3 620)
3	59.0 (7 746)
4	11.9 (1 563)
5	0.2 (21)
Type of hip fractures—percentage	
Intracapsular	39.4 (5 411)
Extracapsular	59.7 (8 218)
Other	0.9 (129)
Type of surgery—percentage	
No surgery	2.6 (354)
Screws	2.2 (304)
Sliding hip screw	1.6 (215)
Intramedullary nail	57.1 (7 746)
Hemiarthroplasty	33.3 (4 526)
Hip prosthesis	2.8 (384)
Other/unknown	0.4 (48)
Type of anesthesia—percentage	
General	6.7 (885)
Neuro-axial	91.9 (12 107)
Other	1.34 (177)
Other specialists in Traumatology Unit—percentage	
Internist	15.6 (2 143)
Geriatrician	79.1 (10 904)
Other	2.0 (281)
None	3.3 (450)
Early mobilization after surgery—percentage	
No	38.2 (5 032)
Yes	61.8 (8 145)
In-hospital mortality—percentage	
No	96.5 (13 298)
Yes	3.5 (447)
30-day mortality—percentage	
No	92.1 (12 247)
Yes	7.9 (1 051)
30-day re-admission—percentage	
Yes	2.7 (348)
No	97.3 (12 535)
30-day re-intervention—percentage	
No	97.8 (12 323)
Yes	1.9 (242)
Other	0.3 (38)

SD, standard deviation; *ASA*, *American* Society of Anesthesiologists

rehabilitation units is variable between regions. This finding is important because benchmarking between the Spanish ACs will make it possible to establish specific criteria of good practice and results [18], defining indicators to be measured and proposing specific quality standards be met to improve quality of care in each hospital, at the regional and national level.

Although data has been collected from 61 hospitals (13,840 patients), the ACs in which more hospitals were involved were the Communities of Madrid, Catalonia, Castile and León, Castile-La Mancha, and Aragon (79% of the patients). This may be due the voluntary participation of the hospitals in the Spanish RFNC, and because the Community of Madrid and Castile and León, for example (31.4 and 14.4 % of the patients, respectively), already had experience with local registries [13, 19]. The registry includes hospitals from 15 of 17 ACs of Spain, and are nearly equally balanced between high-volume academic urban and low-volume small regional hospitals. The number of hospitals is similar to the number of hospitals participating in the Australia and New Zealand Hip Fracture Registry, the Germany Hip Fracture Registry, and the Dutch Hip Fracture Registry (67, 60, and 56 hospitals included, respectively) [20]. However, the incorporation of more hospital is desired, as the 61 hospitals analyzed represent only a 23.8% of all the hospitals in Spain and 2 ACs were not participating at the time the study was conducted [21]. A comparison of the casemix of the patients included in the Spanish Hip Fracture Registry with that recorded by the automated Minimum Basic Dataset (CMBD) collected from all hospitals by the Ministry of Health has been performed and is currently under submission; the results show the audit's casemix is not different from that of all of Spain, though some process indicators such as surgical delay are different, as can be expected from early adopters of a voluntary registry. Mean age of the patients in our series was 86.7 years (SD 5.6), with variations between ACs (p <0.001), with patients being slightly younger in the Balearic Islands (84.3 years, SD 4.4) and the Canary Islands (84.5 SD 5.4), while they were slightly older in others such as Navarre (88.9 years, SD 5.2). These data coincide with previous audits from Spain published by the Community of Madrid registry group (Mean age 85.3 (SD 7.2); 76.3% women), Castile and León registry groups (Mean age 86.6 (SD 6.0); 78.9% women), and Prieto-Alhambra et al. (Mean age 83.6 (SD 6.0); 76.7% women) [3, 13, 19]. The mean age recorded of patients with hip fracture is a clear reflection of the aging of the Spanish population. In 2018, Foreman et al. established a prediction of life expectancy for 195 countries in the world, with Spain occupying the first place; it will be the country in the world with the most life expectancy for both sexes in the year 2040 [16]. The distribution by sex (75% of women) is repeated in other international registries, like the British, Danish or Australian registries [20], and in the USA, only 25–30% of osteoporotic hip fractures occur in men [22]. Other important differences were that men tended to present a higher anesthetic risk score, proxy for more comorbidity (Supplementary Table 1), this finding was also observed in the Danish registry, in which men have most comorbidities as estimated by the Charlson Index as well as mortality [23]. In our study, the percentage of men with an ASA 3 or 4 score was 77.59% compares with only 68% for women (p <0.05).

Table 2 Description of general characteristics of the study participants, by Autonomous Communities (ACs)

Variable Percentage (total number)	Andalusia	Aragon	Asturias	Balearic Islands	Canary Islands	Castile-La Mancha	Castile and Leon
Gender—percentage (p=0.0005)							
Male % (number)	21.7 (56)	23.8 (256)	18.6 (155)	16.7 (5)	22.3 (2)	27.3 (370)	23.6 (469)
Female % (number)	78.3 (202)	76.2 (820)	81.4 (678)	83.3 (25)	77.7 (80)	72.7 (984)	76.4 (1520)
Age—mean ± SD (p <0.001)	85.3 ± 5.4	86.5 ± 5.8	87.3 ± 5.5	84.3 ± 4.4	84.5 ± 5.4	86.9 ± 5.3	87.0 ± 5.7
Surgical delay—mean (range) (p <0.001)	49.6 (1.6–475.0)	55.5 (1.2–744.4)	100.7 (0.98–455.0)	45.3 (2.2–349.1)	119.8 (8.3–501.8)	65.2 (0–617.9)	80.8 (0.05–907.5)
Surgical delay ≤48 h (p <0.001)							
Yes % (number)	67.1 (167)	54.2 (571)	17.6 (134)	80.0 (24)	15.7 (16)	43.5 (567)	31.5 (583)
No % (number)	32.9 (82)	45.8 (483)	82.4 (626)	20.0 (6)	84.3 (86)	56.5 (737)	68.5 (1271)
Length of stay—median (range) (p <0.001)	6.1 (0.2–48.9)	7.4 (0.9–31.1)	13.7 (0–61.2)	3.8 (1.6–17.6)	16.8 (5.9–63.8)	8.0 (0.2–61.6)	8.8 (0.2–64.8)
ASA scale—(p =0.0001)							
1 % (number)	0 (0)	0.3 (3)	0.1 (1)	6.7 (2)	0 (0)	0.4 (5)	0.1 (2)
2 % (number)	15.4 (37)	30.4 (325)	16.4 (133)	40.0 (12)	19.4 (18)	27.0 (310)	29.1 (571)
3 % (number)	80.5 (194)	58.6 (627)	74.5 (604)	53.3 (16)	73.1 (68)	57.4 (658)	60.5 (1187)
4 % (number)	4.2 (10)	10.4 (111)	8.9 (72)	0 (0)	7.5 (7)	14.6 (167)	10.1 (198)
5 % (number)	0 (0)	0.4 (4)	0.1 (1)	0 (0)	0 (0)	0.6 (7)	0.3 (5)
Type of hip fracture—percentage (number) (p =0.0001)							
Intracapsular	42.3 (109)	39.1 (421)	33.9 (282)	36.7 (11)	44.7 (46)	32.9 (446)	43.8 (873)
Extracapsular	57.8 (149)	60.9 (655)	65.0 (541)	63.3 (19)	55.3 (57)	66.7 (903)	56.0 (1113)
Other	0 (0)	0 (0)	1.2 (10)	0 (0)	0 (0)	0.4 (5)	0.2 (3)
Type of surgery—percentage (number) (p=0.001)							
No surgery	3.1 (8)	1.6 (17)	6.6 (54)	0 (0)	1.0 (1)	2.4 (32)	4.7 (91)
Screws	3.1 (8)	3.1 (33)	0.4 (3)	3.3 (1)	0 (0)	2.0 (26)	1.3 (26)
Sliding hip screw	0 (0)	0.1 (1)	0.1 (1)	0 (0)	0 (0)	0.3 (4)	1.2 (23)
Intramedullary nail	57.6 (148)	59.9 (642)	50.9 (414)	63.3 (19)	54.4 (56)	64.0 (855)	54.2 (1056)
Hemiarthroplasty	34.6 (89)	33.0 (353)	38.1 (310)	6.7 (2)	43.6 (45)	30.0 (400)	34.8 (678)
Hip prosthesis	1.6 (4)	2.2 (24)	3.4 (28)	26.7 (8)	0 (0)	0.9 (13)	3.5 (69)
Other/unknown	0 (0)	0.1 (1)	0.5 (4)	0 (0)	1.0 (1)	0.4 (5)	0.3 (5)
Type of anesthesia—percentage (number) (p=0.0001)							
General	0.4 (1)	7.3 (77)	1.5 (11)	0 (0)	1.0 (1)	2.0 (26)	9.5 (175)
Neuro-axial	99.6 (247)	92.5 (975)	94.7 (718)	100.0 (30)	99.0 (101)	98.0 (1270)	90.3 (1673)
Other	0 (0)	0.2 (2)	3.8 (29)	0 (0)	0 (0)	0 (0)	0.2 (4)
Clinical specialists in Traumatology Unit—percentage (number) (p < 0.001)							
Internist	51.6 (133)	51.3 (551)	26.4 (218)	100.0 (30)	1.9 (2)	0.9 (12)	1.4 (27)
Geriatrician	0 (0)	48.7 (523)	72.9 (602)	0 (0)	71.9 (74)	97.7 (1323)	95.1 (1875)
Other	48.5 (125)	0 (0)	0 (0)	0 (0)	24.3 (25)	0.6 (8)	0.5 (10)
None	0 (0)	0 (0)	0.7 (6)	0 (0)	1.9 (2)	0.8 (11)	3.0 (59)
Early postoperative mobilization—percentage (number) (p < 0.001)							

Table 2 (continued)

Yes	36.9 (92)	72.0 (759)	70.8 (537)	80 (24)	65.7 (67)	56.1 (730)	77.4 (1429)
No	63.1 (157)	28.0 (295)	29.3 (222)	20 (6)	34.3 (35)	43.9 (572)	22.6 (418)
In-hospital mortality—percentage (number) ($p < 0.001$)							
Live	98.1 (253)	96.5 (1038)	95.4 (795)	100.0 (30)	100.0 (103)	94.5 (1279)	96.2 (1909)
Died before surgery	0.4 (1)	0.5 (5)	2.3 (19)	0 (0)	0 (0)	1.3 (18)	1.7 (33)
Died after surgery	1.6 (4)	3.1 (33)	2.3 (19)	0 (0)	0 (0)	4.2 (57)	2.1 (42)
Mortality at 30 days*—percentage (number) ($p = 0.001$)							
No	96.8 (245)	96.3 (990)	96.2 (729)	100.0 (30)	97.1 (100)	96.8 (1220)	95.4 (1714)
Yes	3.2 (8)	3.7 (38)	3.8 (29)	0 (0)	2.9 (3)	3.3 (41)	4.6 (82)
Discharged home—percentage (number) ($p < 0.001$)							
Yes	72.1 (186)	46.8 (503)	37.0 (308)	86.7 (26)	71.8 (74)	24.1 (326)	38.6 (762)
No	27.9 (72)	53.2 (572)	63.0 (525)	13.3 (4)	28.2 (29)	75.9 (1027)	61.4 (1210)
Destination at 30 days of patients not discharged home**—percentage (number) ($p < 0.001$)							
In nursing home	25.6 (64)	26.5 (181)	45.3 (255)	10.3 (3)	7.5 (6)	63.0 (555)	50.1 (767)
From own home to nursing home—stay at nursing home (newly institutionalized)	2.8 (7)	1.0 (7)	2.0 (11)	3.5 (1)	1.3 (1)	1.0 (9)	3.3 (50)
From home to acute postoperative centers (rehabilitation facility)—return to home	70.4 (176)	71.9 (492)	51.5 (290)	86.2 (25)	88.7 (71)	35.9 (316)	44.3 (677)
From home to unknown	1.2 (3)	0.6 (4)	1.2 (7)	0 (0)	2.5 (2)	0.1 (1)	2.3 (35)

Variable Percentage (total number)	Catalonia	Extremadura	Galicia	Madrid	Region of Murcia	Navarre	Basque Country	Valencian Community	Overall
Gender—percentage (p=0.0005)									
Male % (number)	25.4 (546)	29.1 (34)	24.0 (152)	23.6 (1024)	27.7 (31)	21.0 (50)	22.9 (22)	29.6 (147)	24.2 (3340)
Female % (number)	74.6 (1600)	70.9 (83)	76.0 (481)	76.4 (3311)	72.3 (81)	79.0 (188)	77.1 (74)	70.4 (349)	75.8 (10,476)
Age—mean ± SD (p <0.001)	86.6 ± 5.5	87.4 ± 5.1	85.7 ± 6.1	86.9 ± 5.5	85.1 ± 5.4	88.9 ± 5.2	87.7 ± 5.33	85.8 ± 5.4	86.7 ± 5.6
Surgical delay—mean (range) (p <0.001)	59.6 (0–816)	66.9 (0.6–674.8)	104. (2.2–586.4)	71.2 (0–840.7)	72.0 (0.4–183.6)	60.5 (4.7–217.8)	63.2 (2.8–163.4)	44.8 (3.6–194.7)	70.75 (0–907.5)
Surgical delay ≤48 h (p <0.001)									
Yes % (number)	49.9 (1034)	51.4 (56)	35.9 (212)	45.0 (1880)	33.3 (36)	39.2 (92)	44.0 (40)	63.4 (312)	43.3 (5724)
No % (number)	50.1 (1040)	48.6 (53)	64.1 (378)	55.0 (2296)	66.7 (72)	60.9 (143)	56.0 (51)	36.6 (180)	56.7 (7504)
Length of stay—median (range) (p <0.001)	9.0 (0.1–51.9)	7.0 (1.7–38.7)	11.2 (0.8–50.0)	9.7 (0.1–124.7)	8.7 (2.9–23.9)	9.5 (0.4–23.1)	9.1 (1.3–31.0)	7.3 (1.0–29.7)	9.0 (0.06–124.74)
ASA scale—(p =0.0001)									
1 % (number)	1.1 (21)	0 (0)	0.6 (4)	0.3 (14)	9.9 (11)	0 (0)	0 (0)	22.6 (112)	1.3 (175)
2 % (number)	31.6 (599)	8.9 (9)	11.5 (73)	28.2 (1186)	29.7 (33)	13.6 (32)	12.2 (11)	54.6 (271)	27.6 (3620)

Table 2 (continued)

3 % (number)	59.4 (1127)	70.3 (71)	45.2 (286)	61.2 (2573)	44.1 (49)	55.1 (130)	62.2 (56)	20.2 (100)	59.0 (7746)
4 % (number)	7.9 (150)	20.8 (21)	42.7 (270)	10.2 (429)	16.2 (18)	31.4 (74)	25.6 (23)	2.6 (13)	11.9 (1563)
5 % (number)	0.1 (1)	0 (0)	0 (0)	0.1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0.2 (21)
Type of hip fracture—percentage (number) (p =0.0001)									
Intracapsular	36.8 (777)	35.0 (41)	47.9 (303)	40.1 (1 729)	31.3 (35)	47.5 (113)	43.8 (42)	36.9 (183)	39.4 (5411)
Extracapsular	60.6 (1282)	64.1 (75)	52.1 (330)	58.9 (2 538)	68.8 (77)	52.5 (125)	46.9 (45)	62.3 (309)	59.7 (8218)
Other	2.6 (55)	0.9 (1)	0 (0)	1.0 (42)	0 (0)	0 (0)	9.4 (9)	0.8 (4)	0.9 (129)
Type of surgery—percentage (number) (p=0.001)									
No surgery	0.9 (19)	6.0 (7)	5.3 (33)	2.0 (85)	1.8 (2)	0.4 (1)	1.1 (1)	0.6 (3)	2.6 (354)
Screws	3.3 (69)	1.7 (2)	0.3 (2)	2.8 (118)	0.9 (1)	0.4 (1)	3.3 (3)	2.2 (11)	2.2 (304)
Sliding hip screw	3.6 (75)	0 (0)	0.3 (2)	0.4 (16)	0 (0)	33.9 (80)	1.1 (1)	2.4 (12)	1.6 (215)
Intramedullary nail	56.7 (1189)	63.8 (74)	49.1 (306)	59.5 (2530)	66.4 (73)	18.2 (43)	46.7 (43)	60.2 (298)	57.1 (7746)
Hemiarthroplasty	30.4 (638)	25.9 (30)	37.4 (233)	33.6 (1427)	30.0 (33)	45.3 (107)	44.5 (41)	28.3 (140)	33.3 (4526)
Hip prosthesis	4.0 (84)	2.6 (3)	7.4 (46)	1.6 (68)	0.9 (1)	0.9 (2)	3.3 (3)	6.3 (31)	2.8 (384)
Other/unknown	1.1 (22)	0 (0)	0.2 (1)	0.1 (7)	0 (0)	0.9 (2)	0 (0)	0 (0)	0.4 (48)
Type of anesthesia—percentage (number) (p=0.0001)									
General	14.7 (302)	2.7 (3)	4.4 (26)	3.6 (151)	7.4 (8)	14.0 (33)	31.4 (27)	8.9 (44)	6.7 (885)
Neuro-axial	84.7 (1744)	97.3 (106)	95.6 (564)	96.1 (3987)	92.6 (100)	86.0 (202)	65.1 (56)	67.9 (334)	91.9 (12,107)
Other	0.7 (14)	0 (0)	0 (0)	0.3 (11)	0 (0)	0 (0)	3.5 (3)	23.2 (114)	1.34 (177)
Clinical specialists in Traumatology Unit—percentage (number) ($p < 0.001$)									
Internist	28.7 (612)	5.1 (6)	5.1 (32)	5.2 (224)	18.8 (21)	0 (0)	90.5 (86)	38.1 (189)	15.6 (2143)
Geriatrician	67.9 (1447)	54.7 (64)	92.6 (586)	87.8 (3809)	80.3 (90)	99.6 (237)	0 (0)	55.2 (274)	79.1 (10,904)
Other	1.0 (22)	2.6 (3)	2.2 (14)	0.9 (41)	0 (0)	0.4 (1)	0 (0)	6.5 (32)	2.0 (281)
None	2.4 (50)	37.6 (44)	0.2 (1)	6.1 (266)	0.9 (1)	0 (0)	9.5 (9)	0.2 (1)	3.3 (450)
Early postoperative mobilization—percentage (number) ($p < 0.001$)									
Yes	35.7 (737)	22.0 (24)	70.0 (411)	63.5 (2633)	40.7 (44)	86.0 (202)	41.8 (38)	85.0 (418)	61.8 (8145)
No	64.3 (1328)	78.0 (85)	30.0 (179)	36.5 (1511)	59.3 (64)	14.0 (33)	58.2 (53)	15.0 (74)	38.2 (5032)
In-hospital mortality—percentage (number) ($p < 0.001$)									
Live	96.3 (2043)	98.2 (115)	96.7 (612)	94.5 (4088)	98.2 (110)	95.4 (227)	91.7 (88)	97.8 (485)	95.6 (13,175)
Died before surgery	1.0 (21)	0.9 (1)	1.6 (10)	1.3 (58)	1.8 (2)	0.8 (2)	4.2 (4)	0.2 (1)	1.3 (175)
Died after surgery	2.7 (57)	0.9 (1)	1.7 (11)	4.2 (182)	0 (0)	3.8 (9)	4.2 (4)	2.0 (10)	3.1 (429)
Mortality at 30 days*—percentage (number) (p = 0.001)									

Table 2 (continued)

No	95.8 (1849)	93.0 (106)	96.2 (588)	97.1 (3786)	99.1 (109)	96.5 (219)	95.5 (84)	98.8 (478)	96.5 (12,247)
Yes	4.3 (82)	7.0 (8)	3.8 (23)	2.9 (114)	0.9 (1)	3.5 (8)	4.5 (4)	1.2 (6)	3.5 (447)
Discharged home—percentage (number) ($p < 0.001$)									
Yes	19.9 (427)	55.7 (64)	70.4 (445)	35.2 (1521)	74.1 (83)	49.2 (117)	46.9 (45)	78.6 (390)	38.3 (5277)
No	80.1 (1716)	44.4 (51)	29.6 (187)	64.8 (2805)	25.9 (29)	50.8 (121)	53.1 (51)	21.4 (106)	61.7 (8505)
Destination at 30 days of patients not discharged home**—percentage (number) ($p < 0.001$)									
In nursing home	47.2 (382)	37.9 (39)	19.5 (108)	42.3 (1114)	10.8 (10)	35.7	32.8 (22)	16.3 (76)	40.9 (3647)
From own home to nursing home—stay at nursing home (newly institutionalized)	1.7 (14)	3.9 (4)	0.2 (1)	3.7 (97)	1.1 (1)	2.2 (4)	4.5 (3)	0.4 (2)	2.4 (212)
From home to acute postoperative centers (rehabilitation facility)—return to home	48.0 (388)	55.3 (57)	80.1 (443)	52.6 (1385)	83.8 (78)	59.9 (109)	62.7 (42)	83.3 (388)	55.3 (4937)
From home to unknown	3.1 (25)	2.9 (3)	0.2 (1)	1.4 (39)	4.3 (4)	2.2 (4)	0 (0)	0 (0)	1.4 (128)

%, percentage; *SD*, standard deviation; *ASA*, *American* Society of Anesthesiologist; *Mortality at 30th days, excluding intra-hospital mortality; **Location of the patients not sent home from the acute surgical hospital following hip fracture

We used the ASA Assessment as suggested by the Fragility Fracture Network (FFN) Minimum Common Dataset [7]. The ASA score can be used as an indirect indicator of comorbidity in hip fracture surgery, as proven by other authors [24].

Spinal anesthesia is the most widely used technique throughout the national territory, homogeneously among all ACs ($p = 0.0001$). However, in the Basque Country, general anesthesia was performed in 31% of patients and in 15% of patients in Catalonia ($p < 0.05$). Spinal anesthesia is also the mainstay in Sweden and Norway. On the contrary, in the UK, half of the surgeries are performed under general anesthesia, which was the preferred type of anesthesia in Australia and New Zealand as well as Germany [20]. The evidence available to date does not allow us to recommend one anesthetic method over the other. The multicenter, randomized REGAIN study could answer this question [25]. The majority of the participating hospitals reported multidisciplinary care with either internal medicine or geriatrics (96.7%). Strong evidence supports interdisciplinary care in these patients, improving outcomes [12, 26]. Published reviews and meta-analysis demonstrate that any model of ortho-geriatric collaboration improves outcomes for older patients [27, 28].

Most Clinical Practice Guidelines and metaanalysis recommend surgery in the first 48 h except in cases of clinical instability [29–31]. Two systematic review and meta-analyses from 2010 [31] to 2018 [29] found that surgery within 48 h was associated with a lower risk of mortality (relative risk [RR] 0.81 [95% CI 0.68–0.96] and RR 0.80 [95% CI 0.66–0.97], respectively). In spite of this recommendation, endorsed by the Spanish Ministry of Health, we found that only 43% of the patients included in the RNFC were operated on in this time interval, with large differences between ACs. Only 5 ACs (Balearic Islands, Andalusia, Valencian Community, Aragon, and Extremadura) operated most of their patients in less than 48 h. Mean surgical delay was 70.75 (SD 61.2) hours ($p < 0.001$). If we consider only the 5 ACs providing the most patients in the RNFC, a 27-h difference of delay to surgery was observed between Aragon (45.2 h) and Castile and León (72.2 h). The ACs with least delay were the Valencian Community (median surgical delay, 44.8 h), Andalusia (49.6 h), and the Balearic Islands (45.3 h), and the AC with the longest delay was the Canary Islands (119.8 h). These differences can be justified by the different healthcare systems existing in Spain; since January 2002, all 17 ACs and the Institute for Health Care Management (INGESA) have organized and managed their public healthcare services with an ample degree of self-government [32]. Compared to other national registries, Spain had, by far, the highest surgical delay [20]. We believe that improvement of surgical delay in our country should be given the highest priority. The variability observed could be used as a benchmarking opportunity. Analysis of the presence and magnitude of existing clinical variability and establishment of measures to improve quality

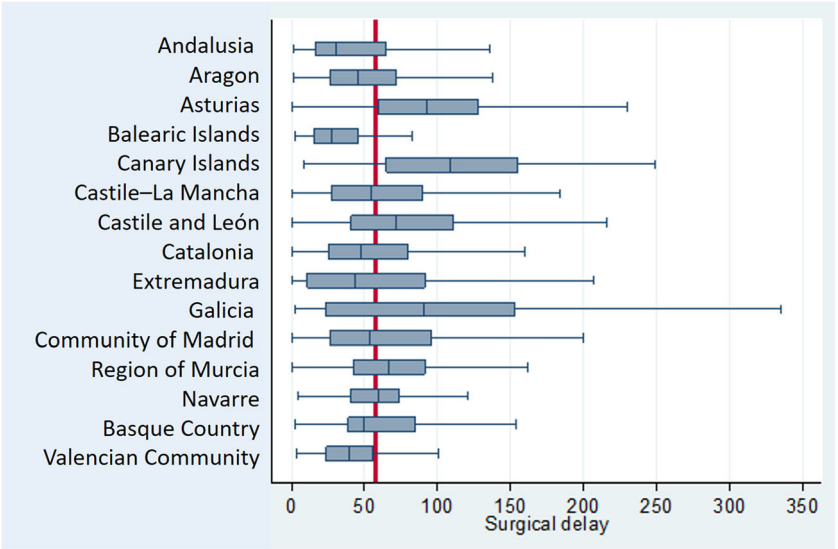

Fig. 1 Median surgical delay excluding outliers and national median as reference (red line) among the 15 Autonomous Communities from Spain participating in the National Hip Fracture Registry

of care is one of the aims of the Spanish RNFC [7]. Hospitals in England, Wales, and Northern Ireland treating acute hip fractures have contributed with registry data since 2007. The data is published annually and is publically accessible, allowing clinical teams and administrators to visualize their results and compare them with national standards, establishing specific criteria of good practices and results, defining indicators for their measurement, and proposing specific quality standards, which should be fulfilled in each hospital, regionally and nationally [33]. The comparison between different hospitals and ACs constitutes in itself an incentive for the application of measures that directly influence the quality of care, improving indicators such as surgical delay.

It is important to note that prompt surgery has been related to average length of stay and costs [5, 34]. The large variability observed in surgical delay between ACs also translates into great heterogeneity in the length of hospital stay. In our study, the Canary Islands and the Principality of Asturias had the longest median surgical delays and hospital length of stay, 119.8 h/16.8 days and 100.7 h/13.7 days, respectively. Among the 5 ACs that contributing the most patients to the RNFC, the largest median length of stay was in the Community of Madrid (9.7 days), and the lowest in Aragón (7.4 days). There was thus 2 more days of acute hospitalization in the Community of Madrid, entailing a high healthcare cost if we consider the high number of patients in this AC. A large randomized controlled trial recently demonstrated that an accelerated care pathway in hip fracture patients led to a significantly shorter length of stay [34]. In Spain, Bartra et al. found notable differences in mean costs across 5 ACs (Andalusia, Catalonia, the Valencian Community, Galicia, the Community of Madrid, and the Basque Country), mainly caused by different lengths of hospital stay and outpatient care in the subsequent months [5]. The reduction in hospital length of stay and associated costs could be tackled with different initiatives such as "pay for performance." In England, this

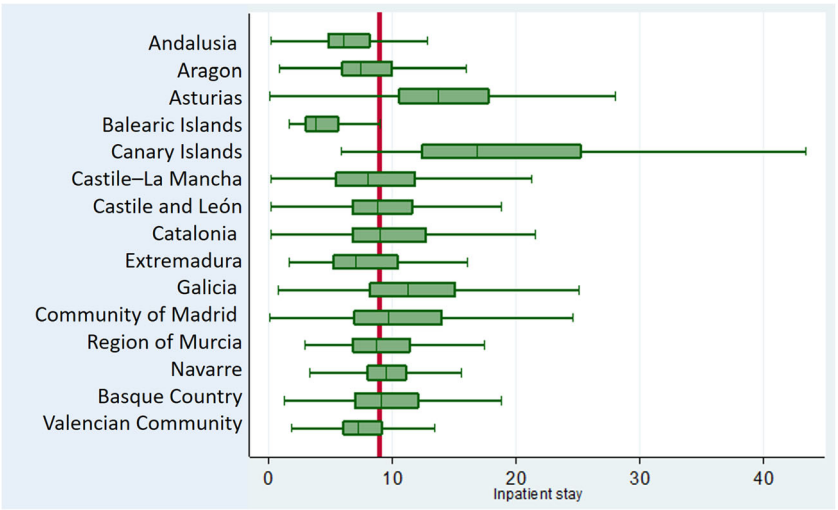

Fig. 2 Median inpatient stay excluding outliers and national median as reference (red line) among the 15 Autonomous Communities from Spain participating in the National Hip Fracture Registry

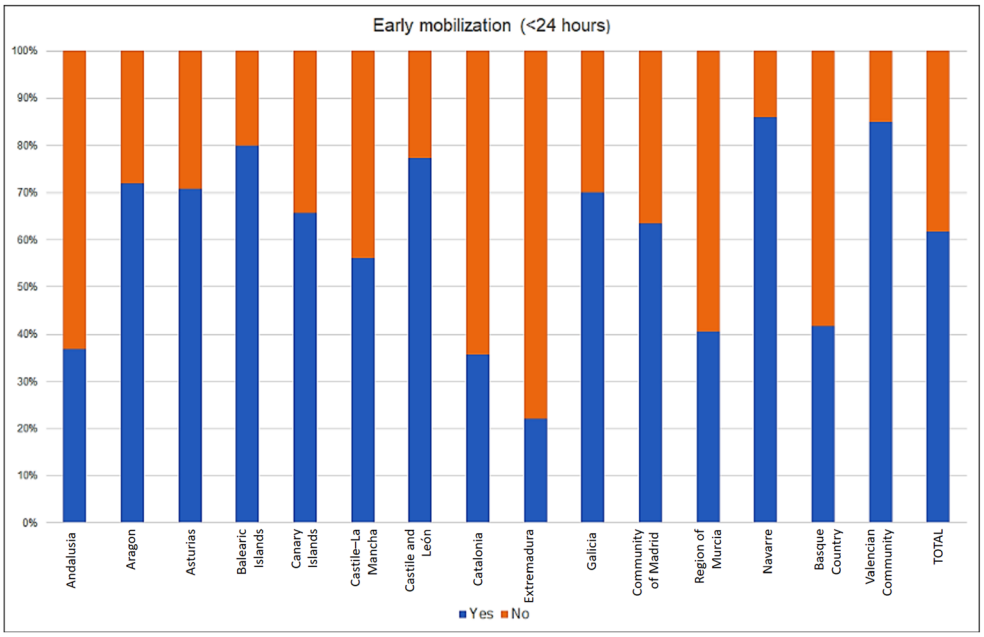

Fig. 3 Percentage of patients mobilized by the first postoperative day among the 15 Autonomous Communities from Spain participating in the National Hip Fracture Registry

program is known as the Best Practice Tariff. Metcalfe et al. published a study in 2019 that shows how a "pay for performance" program improved the results of hip fracture care in England, increasing the proportion of patients who are operated on in the first 36 h, reducing the length of hospital stay and finally reducing mortality and readmissions at 30–60–90 days after hospital discharge [33]. The authors added that these results were not due to the unique application of the "Best Practice Tariff" program, introduced in 2010, but rather that this measure completed the introduction of the hip fracture registry in 2007 [33]. We have to clarify that data about length of stay are also dependent on the availability of rehabilitation resources and functional recovery of patients, which varies greatly throughout Spain. In some hospitals, the rehabilitation phase is included in the acute phase [3, 5, 7]. The destination at discharge from the surgical hospital is highly variable across the 15 ACs ($p < 0.001$). Only 38.3% of the patients returned home at discharge, varying from 19.9 to 86.7% according to ACs. In 2019, using the Canadian national administrative database, Beupre et al. found that in 111,952 patients, only 31.6% returned home, as also observed by us, with a high variability across provinces ($p < 0.001$) [35]. Again, we observed a great variability between ACs in this variable. In Andalusia, the Balearic Islands, the Canary

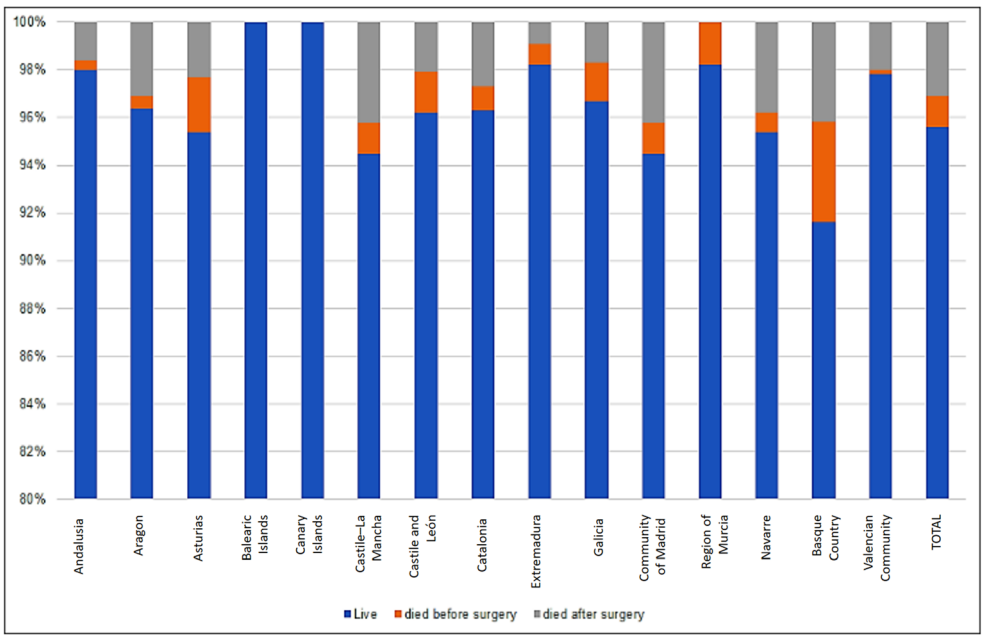

Fig. 4 Percentage of in-hospital mortality among the 15 Autonomous Communities from Spain participating in the National Hip Fracture Registry

Islands, Galicia, the Region of Murcia, and the Valencian Community, more than 70% of the patients returned home, while in the rest of Spain, especially in Castile and León, Castile-La Mancha, Catalonia, and the Community of Madrid, less than 40% of the patients returned directly home. We believe that further work is required to determine the impact of this heterogeneity on patient outcomes and health system costs.

In-hospital mortality was 4.4%. The highest in-hospital mortality was seen in the Basque Country (8.4%). In this community, the average surgical delay was 63.2 h (SD 38.4), and only 44% of patients were operated in the first 48 h. Most notably, this was the AC with the highest percentage of general anesthesia used (31.4%). Desai et al. analyzed 16,695 patients from the Kaiser Permanente Hip Fracture Registry and found that general anesthesia and conversion from regional to general anesthesia were associated with a higher risk of mortality during the in-hospital stay, compared with regional anesthetic techniques (HR, 3.83; 95% CI, 3.18–4.61; $p < 0.001$) [36]. In spite of the available evidence to date not allowing recommending any single anesthetic method, we believe that regional anesthetic technique is desirable since it has been shown to reduce operative times, costs, complications, and mortality.

The percentage of mobilization on the first day was 68%, but again with differences among regions (35.7% in Catalonia vs. 63% in the Community of Madrid) ($p < 0.001$). In other series published, it has been seen that early mobilization and early weight bearing benefits functional recovery [26, 30]. We believe that achieving this objective could be a "low-cost" measure for the national health system, as mobilization in the first 24 h after surgery could be performed by already available personnel (ward nurses) by just modifying hospital policies and implementing rehabilitation protocols.

A limitation of the study is the heterogeneity of the resources both in the acute phase of admission that cause data dispersion, and in the participating hospitals, that are not grouped by similar characteristics which would allow homogenizing the sample. Another limitation is that there is not any consideration about the socio-economic level of each of the analyzed ACs and their potential effect on the results, certainly of interest for future study. The AC healthcare systems are managed by their regional governments and financed through indirect taxation. However, the heterogeneity of the participating hospitals and different levels of complexity of care help give this study more external validity. Moreover, it has been shown that there is no association between surgeon or hospital volume in reoperation rates, medical complications, or unplanned readmissions when treating osteoporotic hip fractures. Okike et al. analyzed 14,294 patients from the Kaiser Permanente Hip Fracture Registry and did not find any association between surgeon or hospital volume and mortality at 30 days, 90 days, or 1 year ($p > 0.05$) [37]. A final limitation is that despite collecting consecutive patients, not all were included; only 79% of patients agreed to participate. We demand consent for participation, as it was required for most ethics boards of the participating hospitals. This is a common feature in many other registries such as the Norwegian Registry or the German Registry. The percentage of patients agreeing to participate between regions did not differ significantly, and the casemix of consenting and non-consenting patients did also not differ significantly. Our study has several strengths; it is a multicentric study of hospitals across Spain that allows both healthcare managers and professionals to assess the care provided regarding the hip fracture management in the elderly. Also, this study is to our knowledge the largest analysis of osteoporotic hip fractures by ACs in Spain.

In conclusion, we can affirm that though medical care is currently protocol-based, there are still differences in hip fracture management in Spain, especially regarding surgical delay, type of anesthesia, early mobilization, and destination at discharge. Further work is required to determine the impact of these differences on patient outcomes and healthcare system costs. We believe the data from this study will be of great value for those responsible for formulating health policies, for the different ACS, and for the hospitals to implement and evaluate hip fracture programs in elderly persons.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11657-021-00906-9.

Declarations

Conflicts of interest None.

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