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Usefulness of the holistic context of frailty as a prognostic factor for the outcome of geriatric patients undergoing emergency abdominal surgery

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Summary
Background This study aims to assess frailty in a holistic context as a prognostic factor for the outcomes of a group of geriatric patients undergoing emergency abdominal surgery, identifying the predictors that could be included in a global assessment score of preoperative frailty.
Methods Four groups of predictors (physical, cognitive, functional, and social) were evaluated in a group of patients selected for abdominal surgery during the preoperative period. The outcomes for three groups of variables (mortality, morbidity, and use of health resources) were measured using multivariate logistic regression when the response variable is categorical, and the multiple linear regression model for continuous numeric response variables.
Results In the period studied, 286 patients aged 65 years or older required an emergency procedure. Physical/phenotypic predictors are consequently related to outcomes of morbidity and mortality and the use of resources, while predictors of mortality and socioeconomic factors predominate in functional and cognitive outcomes. Individually, Mini Nutritional Assessment (short form), sarcopenia, Pfeiffer, Barthel, and Duke tests best predict outcomes after emergency surgery.
Conclusion Frailty is a predictive factor that should be routinely used in emergency geriatric surgery in a holistic context that includes physical, cognitive, functional, and social variables. Designing scores based on a broader concept of frailty will enable a more consistent predictive evaluation. Social frailty may have an important predictive value in the postoperative hospital outcome and in other medical fields, and should be studied in more depth in the future.

Keywords Frailty · Geriatric surgery · Prognostic factor · Morbimortality · Emergency surgery

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Introduction

Frailty is a complex concept which has received several definitions over the years. Initially, a biological syndrome was considered to be characterized by a decrease in homeostasis and resistance to stress, in which vulnerability and disability increased, favoring premature death [1]. Frailty was subsequently considered to be an accumulation of deficits [2]. Frailty is currently accepted to have a broader definition, and is characterized by multisystem dysregulations (physical, cognitive, social) leading to loss of dynamic homeostasis, decreased physiological reserve, loss of a normal relationship with the environment, and increased vulnerability to subsequent morbidity and mortality. This is often manifested in a maladaptive response to stressors, leading to a vicious cycle involving functional decline and other serious adverse health outcomes [3, 4]. Age, genetics, lifestyle, diseases, and the environment are considered risk factors for frailty [5].

Frailty is now considered a risk factor among the elderly for their survival and morbidity and mortality, and therefore a pathophysiological state that must be quantified and measured in order to assess its influence. There is no measure or scale of perfect frailty, although approaches include defining a phenotype (in which specific characteristics such as muscle weak-

ness, gait speed, weight loss, reduced activity, and exhaustion are measured) and the deficit accumulation model (in which a wide range of possible deficits are measured and listed in the form of a relationship). A potential advantage of the latter method is that it can be compiled from a range of commonly used routine data sources [6, 7].

With the ageing population, elderly patients account for a growing percentage of surgical emergencies in hospitals, and postoperative results in this group of patients are currently deficient. The factors contributing to this deficient outcome include frailty, pre-existing comorbidity, polypharmacy, late diagnosis and lack of timely treatment directed by a consultant in geriatric surgery. At least two aspects of medical care must be addressed in order to improve morbidity and mortality rates in geriatric surgery in general and emergency surgery in particular: a precise and timely preoperative evaluation to identify a treatable pathology, and consideration and correction of age-specific disease processes. Identifying patients in whom surgical treatment would be useless or may be associated with a high risk would prevent unnecessary interventions and would also provide patients and caregivers with realistic outcome expectations. The prevention of complications is preferable to rescue treatment, due to the large proportion of patients who fail to recover from adverse events. Even with successful surgical treatment, long-term functional deterioration and increased dependence are quite common [8, 9].

Various types of frailty measurement systems have been used in the biomedical field, especially in oncology, cardiology, surgery/transplants, and trauma. In the surgical field, the PFT (frailty phenotype), gait speed, the FI (frailty index), and the EFS (Edmonton Frailty Scale) have been used; and in trauma the TSFI (trauma-specific frailty Index). These measurement systems have been developed independently of the conceptual changes regarding frailty. If we now consider frailty as a set of deficits rather than a medical syndrome, we must look for independent validation studies with a more overall vision, since these most extensively used measurement systems for frailty partially identify the pre-surgical frailty of elderly people. In addition, the time available to perform frailty assessments is very limited in emergency surgery, due to the need to treat the patient as soon as possible.

This study evaluates frailty holistically as a prognostic factor for the outcomes of a group of geriatric patients undergoing emergency abdominal surgery in a given period of time, based on four groups of predictors (physical, cognitive, functional, and social), measuring the outcome using three groups of variables (mortality, morbidity, and use of resources) based on the following objectives:

1. To assess the influence of each predictor and group of predictors on the outcome of patients who undergo surgery.
2. To identify the predictors that can be part of a global assessment score of preoperative frailty in emergency surgery for the elderly according to new concepts of frailty.

Material and methods

Study population and setting

All patients over 65 years old diagnosed with urgent abdominal pathology in our hospital and requiring immediate or urgent surgical treatment between January 2017 and June 2018 were included in the study. Patients from other hospitals and social-health centers, patients who were candidates for transplants, patients hospitalized in other services of our hospital (including those admitted to the ICU [Intensive Care Unit]) and those requesting referral to our service, those undergoing surgery at other hospitals and admitted to ours due to postoperative complications, patients undergoing previous elective surgery, patients in whom it was not feasible to perform the predictive tests, and patients who died during the brief period of initial preoperative stabilization were all excluded from the study.

Informed consent was obtained for each patient. Ethical approval was obtained from the hospital Clinical Research Ethics Committee.

Data collection

Demographic data (age, sex), diagnosis on admission, and the proposed urgent surgical treatment were initially obtained from each patient. The frailty prediction data were obtained using four groups of predictors that were compiled during the preoperative period:

Physical predictors Data were obtained using the Mini Nutritional Assessment Short Form (MNA SF) [10], which classified patients as having normal nutritional status (12–14 points), at risk of malnutrition (8–11 points), and malnourished (0–7 points); the preoperative total leukocyte count (TLC), with normal reference values of 3500–11,000/mL; preoperative hemoglobin, with reference values of 12.5–17 g/dL; preoperative blood albumin, with reference values of 4.0–5.0 g/dL; and skeletal muscular mass (SMM; %), measured by bioimpedance using a current of 800 μA at 50 kHz using the right ipsilateral tetrapolar method according to the methodology recommended by the National Institutes of Health Technology Assessment Conference Statement of 1994 [11], with the patient in the supine decubitus position. The BioScan 98 (Biological Medical Technology S, Barcelona, Spain)

equipment (normal range 24.3–30.3 for women and normal range 32.9–38.9 for men).

Predictor of cognitive state The Pfeiffer test was applied to assess cognitive deficit (CD), and patients were classified with normal CD (0–2 errors), mild CD (3–4 errors), moderate CD (5–7 errors), and severe CD (8–10 errors). The questionnaire was applied in 5 min.

Predictor of the functional status The Barthel test was used for functional status, which classified patients as independent (score of 100), with mild dependence (60–95), moderate dependence (40–55), severe dependence (20–35), or total dependence (less than 20). The questionnaire takes 5 min to obtain the information.

Predictor of the social situation The Duke University of North Carolina Functional Social Support Questionnaire (Duke-UNC) [12] protocol was applied, with a range between 11 and 55 points. A score lower than 32 indicates low social support, and a score of 32 or over indicates normal social support. The questionnaire is applied in 3 min.

All data were obtained by the surgeons who prepared the patients for surgery, and in those predictors requiring it based on the information provided by the patients and their relatives. Prior to the beginning of the study, emergency surgeons were trained to assess geriatric patients using the frailty scales and tests.

The variables for assessing the effect of frailty on the outcome of patients included in this study were classified into three groups:

1. *Mortality:* postoperative and 3 months after hospital discharge (regardless of the patient's destination: home or social institution).
2. *Morbidity*: pneumonia (initially diagnosed with chest x-ray and CT if necessary.), urinary infection (diagnosed with changes in the clinical or functional situation of the elderly person (confusion, dehydration, prostration, etc.) not justified by other circumstances and confirmed by the laboratory), pulmonary thromboembolism (PTE; diagnosed radiologically), delirium (clinically diagnosed according to DSM IV criteria, such as cerebral, organic, multifactorial etiology, characterized by alterations of consciousness, attention, perception, thought, memory, psychomotor behavior, emotions, and/or the sleep–wake cycle) [13], surgical site infection (clinical diagnosis according to the National Health System [NHS] Clinical Guideline by National Institute for Health and Care Excellence [Nice]) [14], and sepsis (APACHE [Acute Physiology And Chronic Health Evaluation] score) [15].
3. *Use of resources*: length of hospital stay (calculated from the day of admission to the hospital to the discharge to home or social institution), post-discharge recovery in a social institution, unforeseen ICU stay (due to complications during the postoperative period). The criteria for referral of a patient to a social-health center were those patients who at the time of hospital discharge: a) presented functional and/or cognitive impairment; b) presented a loss of functional autonomy susceptible to improvement; c) patients with a lack of adequate socio-family support in the postoperative period; and d) people who did not comply with any of the above profiles, but required treatment guidelines that could not be followed at home because they did not have adequate support. The health centers where the patients were to referred are dependent on our hospital care.

Statistical analysis

Categorical (dichotomic and ordinal) variables are described as a number with the corresponding percentages. Continuous variables are described as mean with standard deviation, or for non-parametric data, a median with interquartile range (IQR). Most continuous numerical variables have been transformed into ordinal categories: MNS-SF, TLC, hemoglobin, albumin, SMM, Pfeiffer and Barthel questionnaires, and Duke-UNC protocol. To estimate the effect of

Table 1 Categorization of the variables of the study

Variable	Group	Typology	Calculation
Mortality postoperative	Mortality	Dichotomic	Pre-existing
Mortality 3 months	Mortality	Dichotomic	Pre-existing
Pneumonia	Morbidity	Dichotomic	Pre-existing
UTI	Morbidity	Dichotomic	Pre-existing
TPE	Morbidity	Dichotomic	Pre-existing
Delirium	Morbidity	Dichotomic	Pre-existing
Wound infection	Morbidity	Dichotomic	Pre-existing
Anastomosis dehiscence	Morbidity	Dichotomic	Pre-existing
Length hospital stay	Health Management	Numeric	Pre-existing
Recovery postdischarge in social institution	Health Management	Dichotomic	Pre-existing
Imprevist ICU	Health Management	Dichotomic	Pre-existing

UTI Urinary tract infection, *PTE* Pulmonary Thromboembolism, *ICU* Intensive Care Unit

each frailty predictor and group of frailty predictors (nutritional, social, physical, cognitive) on the outcome, multivariate logistic regression was used when our response variable was categorical, and the multiple linear regression model for continuous numeric response variables (length of hospital stay; Table 1).

In order to assess the goodness of fit and the predictive power of each regression, we used the following indicators: the groups were compared using the chi-square test (Fisher's exact tests if appropriate) for categorical data, and Student's t-test or the Mann–Whitney U test for continuous data; R squared for logistic regression, calculated using the McFadden method; the Brier Score was used for the accuracy of probabilistic predictions. Results were regarded as being statistically significant at $p < 0.05$. All statistical analyses were carried out using the Statistical Package for the Social Sciences, version 23 for Windows (SPSS Inc., Chicago, IL, USA).

Results

During the study period and after ruling out patients who did not meet the inclusion criteria (other hospitals and social-health centers; n=47), patients who were candidates for transplants (n = 39), patients hospitalized in other services of our hospital including those admitted to the ICU and those requesting referral to our service (n = 21), those undergoing surgery at other hospitals and admitted to ours due to postoperative complications (n = 13), patients undergoing previous elective surgery (n = 7), patients in whom it was not feasible to perform the predictive test (n = 14), and patients who died during the brief period of initial preoperative stabilization (n = 11), 286 patients 65 years or older in the hospital's emergency department had diagnoses requiring an emergency procedure. Their average age was 78.6 (5.4) years, 54% of this cohort was female, and 46% was male.

The most common surgical indications were intestinal obstruction (26.4%), gastrointestinal perforation (11.1%), complicated colonic diverticulosis (12.9%), cholecystitis (12.4%), appendicitis (8.6), complicated abdominal wall hernia (7.7%), and intestinal ischemia (6.3%). Other presentations of emergency abdominal pathologies were abdominal trauma (1.7%), acute pancreatitis (1.4%), cholangitis (3.8%), upper (2%) and lower gastric (1.3%) hemorrhage, hepatic bleeding (0.7%), rectal foreign bodies (0.3%), gastric stenosis (0.3%), and generalized peritonitis (3%). The most frequent procedures were intestinal resection (58%), cholecystectomy (17.8%), appendectomy (8.7%), and gastrectomy (2.8%).

The descriptive results for the predictive variables are presented in Table 2. 38.9% of the patients entered the emergency room with a normal nutritional status, while 61.1% were malnourished or at a risk of malnutrition. In the preoperative blood analysis, 86% of the patients had normal TLC values, 58.4% of the patients had a percentage of skeletal muscle mass below normal levels. 46.2% of the patients completed the Pfeiffer test with normal values, while 53.1% had an abnormal cognitive deficit (mild and moderate). Only 10.8% of the patients had normal Barthel test results, while 47.9% had a moderate physical/functional deficit on hospital admission, whereas it was severe for 41.3% (medium and high dependency, respectively, for their ADL). 21.7% had low social support prior to hospital admission.

Table 2 Descriptive results of predictive variables

	n	%
MNA SF		
Malnourished	84	29.5
Risk	91	31.6
Normal	111	38.9
TLC		
Low	30	10.5
High	10	3.5
Normal	246	86
HEMOGLOBIN		
Low	157	54.9
High	0	0
Normal	129	45.1
ALBUMIN		
Low	108	37.8
High	0	0
Normal	178	62.2
PFEIFFER		
Normal	132	46.2
Mild	2	0.7
Moderate	152	53.1
BARTHEL		
Normal	31	10.8
Mild	0	0
Moderate	137	47.9
Severe	118	41.3
Total	0	0
SMM		
Normal	119	41.6
Low	167	58.4
DUKE-UNC		
Normal	224	78.3
Low	62	21.7

MNA SF Mini Nutritional Assessment Short Form, *TLC* Preoperative Total Leukocyte Count, *SMM* Skeletal muscular mass, *Duke-UNC* Duke-University of North Carolina Functional Social Support Questionnaire

The descriptive results of the events are presented in Table 3. 51 patients (17.8%) died in the immediate postoperative period, and 27 patients (9.4%) up to 3 months after hospital discharge, regardless of their destination. Total mortality in the period of 3 months: 27.2%. 15% of the patients had to be admitted to the ICU unexpectedly due to postoperative compli-

cations. 29.4% of the patients were referred to a social institution after hospital discharge prior to being finally discharged to their home. As regards morbidity, 18.9% of the patients were diagnosed with pneumonia acquired in the hospital, 16.1% with urinary tract infection, 7.7% with TPE, 6% with sepsis, and 16.8% with surgical wound infection. The most common postoperative complication was delirium (43.4%). The average hospital stay was 10.2 days.

In multivariate analysis (multivariate logistic regression), all the predictive groups were sensitive to a greater or lesser extent in the prediction of morbidity, mortality, and in the variables of use of resources studied (Table 4). As regards the groups of predictors, the physical predictors were those associated with the most outcome events (9 out of 11 studied: postoperative mortality, mortality at 3 months, discharge to a social institution, pneumonia, UTI, unexpected admission to ICU, PE, sepsis, delirium), followed by functional predictors (5: postoperative mortality, 3-month mortality, admission to a social institution, unexpected admission to ICU, delirium), cognitive outcomes (4: postoperative mortality and mortality at 3 months, hospital discharge to a social institution, and delirium), and social (4: mortality at 3 months, hospital discharge to social institution, delirium, and TEP). The physical predictors are consequently related to the outcomes of morbidity and mortality and use of resources, while the functional and cognitive predictors of mortality and socioeconomic factors predominate, and only the event of delirium is morbidity. When the results between the groups of predictors are combined, it turns out that the physical predictors plus the social predictors can predict all the events analyzed. Individually, MNA SF, SMM, Pfeiffer, Barthel, and Duke-UNC are better predictors of outcomes after emergency surgery, due to being associated with more events than the total analyzed in the study. Table 4 shows the events with which each predictor is related individually.

Following the multivariate analysis, and presenting the data by outcome, the following results are observed:

Mortality

Postoperative mortality is associated with MNA SF with a risk of malnutrition (OR 1.89, p 0.032), MNA SF of malnutrition (OR 1.57, p 0.14), low albumin (OR 2.94, p 0.038), low SMM (OR 2.78, p 0.022), and severe functional deficit (Barthel; OR 2.14, p 0.047). It is the most predicted event.

Mortality at 3 months after hospital discharge is associated with low SMM (OR 1.78, p 0.035), Pfeiffer test with a moderate cognitive deficit (OR 1.87, p 0.039), severe functional deficit (Barthel; OR 1, 71, p 0.039), and low levels of social support on the Duke-UNC scale (OR 1.85, p 0.048).

Table 3 Descriptive results of the events

	n	%
Postsurgical hospital mortality		
No	235	82.2
Yes	51	17.8
Mortality after discharge		
No	259	90.6
Yes	27	9.4
Total mortality at 3 months	78	27.2
Discharges to social institution		
No	124	59.6
Yes	84	40.4
Pneumonia		
No	232	81.1
Yes	54	18.9
UTI		
No	239	83.9
Yes	47	16.1
PTE		
No	264	92.3
Yes	22	7.7
Delirium		
No	162	56.6
Yes	124	43.4
Unexpected admission to ICU		
No	243	85
Yes	43	15
Sepsis		
No	269	94
Yes	17	6
Wound infection		
No	238	83.2
Yes	48	16.8

UTI Urinary tract infection, *PTE* Pulmonary Thromboembolism, *ICU* Intensive Care Unit

Morbidity

Postoperative delirium is associated with MNA SF of malnutrition (OR 1.74, p 0.042), low SMM (OR 2.76, p 0.021), mild cognitive deficit (Pfeiffer; OR 1.98, p 0.032), severe cognitive deficit (Pfeiffer; OD 5.39, p 0.001), severe functional deficit (OR 1.33, p 0.52), and low levels of social support (Duke-UNC; OD 2.43, p 0.035). Pneumonia is associated with MNA SF risk of malnutrition (OR 2.46, p 0.024). UTI is associated with age (OR 1.12 p 0.01), MNA SF risk of malnutrition (OR 6.81, p 0.005), MNA SF of malnutrition (OR 4.05, p 0.053), and low albumin (OR 1.31, p 0.022). Postoperative sepsis is associated with MNA SF of malnutrition (OR 2.56, p 0.023), low TLC (OR 6.93, p 0.026), and low SMM (OR 2.10, p 0.029). Infection of the surgical wound is associated with low hemoglobin (OR 2.28, p 0.021) and low albumin (OR 2.12, p 0.051). Finally, the TEP is associated with low social support

Table 4 Multivariate logistic regression model

Factor	Effect	OR (95% CI)	*p-value*
Edad	UTI	1.12 (1.03–1.22)	0.01
Physical predictors			
MNA SF (risk of malnutrition)	Postsurgical mortality	1.89 (0.04–0.87)	0.032
	Pneumonia	2.46 (0.78–1.76)	0.024
	ITU	6.81 (1.78–26.08)	0.005
MNA SF (malnourished)	Postsurgical mortality	1.57 (0.02–0.43)	0.014
	Discharge to social institution	1.21 (0.43–3.42)	0.019
	ITU	4.05 (0.88–18.65)	0.053
	Delirium	1.74 (0.37–2.93)	0.042
	Sepsis	2.56 (0.30–8.48)	0.023
TLC (low)	Unexpected admission to ICU	3.71 (0.99–13.91)	0.052
	Sepsis	6.93 (1.26–37.99)	0.026
Hemoglobin (low)	Wound infection	2.28 (0.10–3.73)	0.021
Albumin (low)	Postsurgical mortality	2.94 (1.06–8.13)	0.038
	ITU	1.31 (0.11–1.84)	0.022
	Wound infection	2.12 (0.87–5.14)	0.051
SMM (low)	Postsurgical mortality	2.78 (0.76–3.18)	0.022
	Mortality 3 months	1.78 (0.19–3.46)	0.035
	Delirium	2.76 (1.17–6.51)	0.021
	Unexpected admission to ICU	2.92 (0.77–3.08)	0.026
	Sepsis	2.10 (0.24–4.76)	0.029
Cognitive predictor			
Pfeiffer (mild)	Discharge to social institution	1.57 (0.27–1.23)	0.046
	Delirium	1.98 (0.81–4.80)	0.032
Pfeiffer (moderate)	Mortality 3 Months	1.87 (0.24–3.22)	0.039
	Discharge to social institution	2.94 (1.22–7.08)	0.016
	Delirium	5.39 (2.25–12.88)	0.001
Functional predictor			
Barthel (moderate)	Discharge to social institution	1.09 (0.21–2.66)	0.035
Barthel (severe)	Postsurgical mortality	2.14 (0.02–3.15)	0.047
	Mortality 3 months	1.71 (0.16–2.27)	0.039
	Discharge to social institution	1.42 (0.23–0.68)	0.015
	Delirium	1.33 (0.07–0.65)	0.052
	Unexpected admission to ICU	1.48 (0.01–2.62)	0.016
Social predictor			
Duke-NSC (low)	Mortality 3 months	1.85 (0.26–2.78)	0.048
	Discharge to social institution	1.71 (0.31–2.61)	0.042
	PTE	4.84 (1.04–22.52)	0.045
	Delirium	2.43 (1.06–5.54)	0.035

MNA SF Mini Nutritional Assessment Short Form, *TLC* Preoperative Total Leukocyte Count, *SMM* Skeletal muscular mass, *Duke-UNC* Duke-University of North Carolina Functional Social Support Questionnaire, *ICU* Intensive Care Unit, *UTI* Urinary tract infection

(Duke-UNC; OR 4.84, p 0.045). Delirium is the most predicted event.

Variables of use of resources

Referral to a social institution after hospital discharge is associated with MNS SF of malnutrition (OR 1.21, p 0.029), mild cognitive deficit (Pfeiffer; OR 1.57, p 0.046), severe cognitive deficit (Pfeiffer; OD 1.42, p 0.015), moderate functional deficit (Barthel; OR 1.09, p 0.035), severe physical-functional deficit (Barthel; OR 1.45, p 0.015), and low social support (Duke-UNC; OR 1.71, p 0.042). Unexpected admission to the ICU during hospital admission is related to low TLC (OR 3.71, p 0.052), low MME (OR 2.92, p 0.026), and severe physical/functional deficit (Barthel; OR 1.48, p 0.016). Referral to a social institution is the most predicted event. Age is a factor that predicts unexpected admission to the ICU in the postoperative period: the older the patient, the greater the risk (OR 1.12, p 0.02).

Table 5 Multiple linear regression model for length of hospital stay

	B (SD)	t	*p*-value
SEX	0.555 (0.36)	1.56	0.12
AGE	–0.025 (0.03)	–0.761	0.447
MNA SF	0.417 (0.09)	3.183	*0.048*
TLC	0.000 (0.00)	1.569	0.118
HB	–0.314 (0.21)	–1.525	0.128
ALBUMIN	–0.023 (0.69)	–0.034	0.973
PFEIFFER	0.428 (0.14)	3.091	*0.002*
BARTHEL	0.000 (0.01)	0.034	0.973
SMM	–0.482 (0.14)	–2.907	*0.044*
DUKE-UNC	–0.404 (0.03)	–3.148	*0.042*

MNA SF Mini Nutritional Assessment Short Form, *TLC* Preoperative Total Leukocyte Count, *SMM* Skeletal muscular mass, *Duke-UNC* Duke-University of North Carolina Functional Social Support Questionnaire
Italic values mean p less than 0.05
Model: ($F(10.271) = 3.654$, $p < 0.001$, $R^2 = 0.119$)

In the analysis of the multiple linear regression model for days of hospitalization (F (10,271) = 3.654, $p < 0.001$, R2 = 0.119), a statistically significant association was observed between the length of hospital stay and the variables SMM, MNA SF, Pfeiffer, and Duke-UNC: the patients hospital stay lengthened with greater loss of muscle mass, worse degree of malnutrition, worse cognitive deficits, and worse social support (Table 5).

Discussion

There is strong evidence that frailty in elderly people is a risk factor during the hospitalization of these patients and in geriatric surgery in particular. This risk has been specifically associated with an increase in hospital stay, an increase in postoperative mortality, and an increase in postoperative complications. Several studies have been published that associate frailty with a predictive value in postoperative morbidity and mortality [16]. Some authors have even proposed preoperative frailty assessment scores, to provide the surgeon with information about the advisability of operating on elderly patients based on the prognosis assessed with these scores. [17, 18]. This concept has also aroused a great deal of interest and debate in the field of geriatric surgery in recent years.

Frailty is therefore an important factor, since the information provided can determine the decision about the advisability of operating on an elderly patient. If the situation is also an emergency or urgent, the decision times are shorter, and decisions must be taken quickly. However, there are two problems that can arise when frailty is considered a measurement of a surgical prognostic factor: What do we understand by frailty? and Are the measurement parameters of frailty correct?

There is some consensus defining frailty as a clinical state in which there is an increase in an individual's vulnerability to developing increased dependence and/or mortality when exposed to a stressor [19]. In practice, while frailty was initially considered to be a decline in reserve and function across multiple physiological systems (the phenotypic model), frailty has now been extended to other aspects, such as the social, cognitive, and functional spheres (holistic approach). However, scores have been designed to assess frailty based on the initial definition: as many as 21 different scores have been found to measure preoperative frailty [20] based on this initial predominantly physical/phenotypic concept of frailty, and only two papers partially introduce the assessment of cognitive aspects. A specific preoperative assessment score for frailty in emergency surgery has been published [21], but it also only includes variables for the physical state of the patients.

The objective of this study was the predictive evaluation of a broader concept of frailty, including cognitive, functional, and social aspects of this decline in the multisystemic reduction of elderly patients as well as the physical aspects. This comprehensive evaluation of frailty has been applied to emergency abdominal surgery, where time is scarce—both for assessing the frailty of the patient and for deciding, on that basis, on the best therapeutic attitude in terms of risk/benefit. Furthermore, in emergency surgery, the assessment of frailty is more important because the resistance expected from elderly patients is greater than in other clinical situations. The calculated outcomes include initial and 3-month mortality, postoperative morbidity, and other variables in the area of the use of resources and health management (hospital stay, referral after hospital discharge to social-health centers, and unexpected admission to the ICU in the postoperative period).

To assess frailty, we decided to select tests, scores, and protocols according to two criteria: that they were used routinely in geriatrics and accepted as clinically valid, and that they could be performed in a short period of time and would not act as an overload on the patient. Consequently, in the cognitive, functional, and social sphere, we ruled out introduc-

ing the parametric assessment of a given variable, and instead chose broad scales of measurement for each of these aspects. The physical variables included nutritional status, sarcopenia, and blood values for albumin, hemoglobin, and TLC. These parameters are considered the most appropriate for evaluation of the physical/physiological state of frail elderly patients during the preoperative period (shrinking, exhaustion, slowness, weakness, low physical activity) [22, 23]. The MNA SF is a simple and useful instrument and the one most frequently used to assess the nutritional risk in elderly people in clinical practice, and it can be applied quickly during the preoperative period. The measurement of muscle mass by bioelectrical impedance is a popular alternative and is easy to use in both research and clinical settings [24]. Although both CT and MRI are more sensitive to small changes in muscle mass, in an emergency surgery scenario there is no time to perform these radiological tests when they are not indicated for the patient's urgent pathology.

The Barthel index was selected to assess the functional capacity of the patient. It is commonly used in clinical practice to describe basic ADL. These activities are considered as "core" to functional assessment, besides being applicable in a short time (unlike other indexes such as the Nottingham or Lawton scales), essential in our work, and easy for the patient to understand. It has a very good predictive value for mortality, the duration of hospital stay, and destination on discharge of hospitalized patients. Its validity and reliability have been amply demonstrated [25].

The cognitive capacity of the patients was evaluated with the Pfeiffer test (Short Portable Mental Status Questionnaire). The questionnaire to assess cognitive ability was selected based on three conditions: it be carried out quickly (less than 5 min), medical personnel were familiar with it, and it provided guarantees of specificity and sensitivity [26]. The Pfeiffer test was selected because it met all three criteria.

Social frailty was included in this work in an original way and based on the little or no interest it has received as a predictive factor for morbidity and mortality in geriatric surgery. Scales of social frailty can normally be used to assess social support and social settings and roles [27]. Three criteria were defined to select an established scale of social frailty: it had to be adequate for geriatric surgery, quick to obtain (less than 5 min), and have good validity and sensitivity. The UNC-Duke (Functional Social Support Questionnaire) was selected.

The physical predictive variables selected predict morbidity and mortality, as shown in other studies [20], with some qualifications observed in this study. First, undernutrition/malnutrition using the MNA SF predicts preoperative mortality but not mortality at 3 months. Second, the assessment of sarcopenia by bioimpedance can predict the post-surgical outcome of emergencies in geriatrics in the same way as radiological techniques, meaning that it can be used in emergency surgery, saving preoperative time; in addition, sarcopenia predicts better the mortality after hospital discharge than MNA SF. Third, the physical variables separately do not predict all the morbidity/mortality parameters or the parameters of use of health resources analyzed in the study.

Functional and cognitive predictors can predict mortality sometime after hospital discharge and the use of health resources, but they are not very useful in predicting postoperative morbidity, except for delirium. The Barthel test had been used for preoperative and postoperative assessment as a predictor of the patient's loss of functionality in trauma surgery [28] and in programmed abdominal and cardiac surgery [29], but its use in emergency surgery was yet to be evaluated. The results of this study can provide further information for developing a predictive score of frailty in the broadest sense. The Mini Mental State Examination (MMSE) is normally used to assess the patient's cognitive status in the preoperative period, but the time required to perform the test is not available in emergency surgery. We have confirmed that the Pfeiffer test has a predictive value for the measurement of preoperative frailty, meaning that it can replace the MMSE in emergency situations. The results obtained in the study are consistent with those obtained in other studies in non-surgical areas [30].

The scores used to assess the prognosis of patients in emergency situations provide valuable information as a bedside decision-making tool for counseling patients and family members, as well as for an adequate risk adjustment in comparative evaluation efforts of the quality of this type of surgery. However, this prediction does not eliminate the patient's urgent pathology, with surgery being the only solution to attempt a therapeutic approach with a possible cure or palliation. These scores consequently predict the risk of postoperative morbidity and mortality, but they cannot prevent surgical indication.

Frailty as a prognostic factor for outcomes in hospitalized patients and emergency surgery in particular is a field that has yet to be studied. This study provides results for developing a useful research field. We observed how social frailty predicts mortality at 3 months, referral to a social institution after hospital discharge, and postoperative delirium. These are results that can open the door to the inclusion of social frailty as a predictive factor for surgery in elderly patients.

The duration of hospital stay has an important value in terms of the use of health resources, since it can negatively affect the minimization of costs for the hospital [31]. In our study, the MNA SF and the SMM as physical variables, cognitive status, and social support are predictors of a longer hospital stay for elderly operated patients, with the consequent results for morbidity (especially delirium) and in the financial sphere. These results are consistent with published

works [32, 33], although they have not measured the frailty as a predictive factor in the elderly surgical patients.

In conclusion, frailty is a predictive factor that should be used routinely in emergency geriatric surgery, in a holistic context that includes physical, cognitive, functional, and social variables, since no predictor is able to predict all the selected variables alone. The level of frailty of an elderly person provides valuable information for risk/benefit decision-making concerning the patient in situations in which there is little time to act. Although the scores currently used to assess preoperative frailty are mainly based on physical/phenotypic variables, the design of scores based on a broader concept of frailty will enable a more consistent predictive evaluation. Social frailty may have an important predictive value for postsurgical hospital outcomes and all specialities, and should be studied in more depth in the future.

Conflict of interest F. Fuertes-Guiró, E. Vitali-Erion, and A. Rodriguez Fernandez declare that they have no competing interests.

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