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Original article

Role of frailty in functional recovery after hip fracture, the variable impact in restoring autonomy

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Abstract. *Background:* In an old or very older adult, frailty is a common geriatric syndrome resulting from aging-associated decline including loss of autonomy related to multiple pathologies. It is necessary to characterize the professional, rational plan for the organization model. *Aim:* The study aims to evaluate the frailty affects on functional and rehabilitative recovery of the elderly patient. *Design:* This is a retrospective study of subjects over 65 years old who underwent hip surgery following a traumatic femoral fracture. *Setting:* Patients admitted to intensive rehabilitation department after hip fracture event. *Population:* The study include records of 350 patients over-65-year-old with hip fracture treated in hospital with surgery. *Methods:* Patients enrolled were classified into three groups: youngest-old, ages 65 to 74 years; middle-old, 75 to 84 years; and oldest-old, ≥85 years. Each patient underwent a multidimensional evaluation capable of identifying the deficient domains, defining the presence of frailty, and the different degrees of severity. All patients underwent a project and rehabilitation program according to the literature protocol. *Results:* The average age of the enrolled patients was 73.2 ± 5.6, 38.6% were over 75 years of age, mostly females (58.9%). The prevalence of frailty increased with age, and cognitive functions were associated with both the frailty measured with the Rockwood and Lacks scales. The recovery of Barthel and Tinetti scores correlates to the level of fragility. *Conclusion:* The approach based on the diagnosis and treatment of the individual disease should be radically changed to a culture and an assessment capacity of elderly persons that take into account the indicators which characterize it as comorbidity, psychological, cultural factors, and environmental health status. *Frailty* is the sum of these conditions, and it is the most impacting variable in the recovery of autonomy. *Clinical Rehabilitation Impact:* The approach based on the diagnosis and treatment of the individual disease should include comorbidity, psychological condition, cultural factors, and environmental health status. (www.actabiomedica.it)

Key words: femoral fracture, older adults, frailty, rehabilitation.

Introduction

Patients with hip fracture have a 25% reduction in life expectancy compared to general population(1). Over half will have persistent disability a year after fracture (2). Different factors influence hip fracture outcome and their identification could be useful to guide multiple aspects of care including prognostic discussion and targeted intervention.

With increasing life expectancy and the number of people with chronic diseases, the emphasis should be placed on "well-being" and the ability to adapt and manage different conditions. One of the risks associated with the definition of WHO health in the 1940s

would be to medicalize the whole society, look for perfect unattainable health, and make "most of us feel unhealthy, most of the time.". Therefore, the concept of health becomes the ability to adapt and manage oneself in the face of the social, physical, and emotional challenges to which life certainly exposes (3,4).

Physical Medicine and Rehabilitation is the branch of medicine that highlights this concept of the person's centrality through the *International Classification of Functioning, Disability and Health* (*ICF*), enhancing what can be used in a sharing goal. We studied the connotation of the "rehabilitation" therapeutic objective on patients undergoing osteosynthesis in a femoral fracture in advanced age, discerning that functional recovery's objective is not only and not so much related to the fracturing index event but above all to the frail condition of elderly patients (5-8).

Regardless of the conceptual, and therefore pathophysiological and nosographic, interpretation of frailty, from a clinical point of view, the definition of "frail elderly" as "a subject of advanced or very advanced age, suffering from multiple chronic pathologies, clinically unstable, frequently disabled, is shared, in whom socio-economic problems often coexist, such as loneliness and poverty above all"(9,10). Facing such a complex patient, the most appropriate study and diagnostic definition methodology seem to be *multidimensional evaluation* (*VMD*). At the basis of such a biological and clinical complexity, there is probably the interaction of the different "dimensions."

The study aimed to verify, in a sample of subjects over 65-year old who underwent hip surgery following traumatic femoral fracture, the association between frailty and return to pre-morbid function, discharge destination, and quality of life after surgery warrants further research.

Materials and Methods

Clinicians evaluated all patients discharged during 2018, on average 90 days after discharge. We compare this outpatient clinical evaluation to the first assessment carried out in the hospital stay.

Inclusion criteria are age ≥ 65 years, a proximal femur fracture (pertrochanteric, femoral neck and subtrochanteric) following low energy trauma, and unrestricted-weight bearing.

We analyzed 350 patients, already admitted to intensive rehabilitation at the Unit of Physical and Rehabilitation Medicine of ASST G. Pini - CTO Hospital, in Milan (Italy).

Exclusion criteria are cognitive impairment (MMSE value with cut off ≤ 18), cardiac diseases, neurological diseases not compliant with the proposed rehabilitation program . We also exclude all patients who were not surgically treated and patients with diagnosis of periprosthetic or pathological fracture.

Within the first 5 days of hospitalization, each patient underwent a multidimensional evaluation capable of identifying the deficient domains, defining frailty's presence, and the different degrees of severity. All patients underwent a project and rehabilitation program according to the literature protocol for patients with femoral fractures. The average length of stay was 21 days, with a range between 19 ± 39 days. The following variables were analyzed: a) clinical-anamnestic; b) biological variables and routine biohumoral parameters; c) hemodynamic variables (i.e., blood pressure, heart rate, ECG); d) physical performance measures (i.e., amount of work, K-calories consumed during rehabilitation training, walking test); e) morpho-anthropometric variables (i.e., weight, height, waist and hips circumference); f) outcome variables (e.g., major cardiovascular events, transient ischaemic attack, stroke, hospital re-hospitalization for acute after discharge, worsening of frailty, worsening of functional status due to complications).

The multidimensional evaluation (VMD) included:

1. Cognitive assessment:
    a. *Mini-Mental State Examination* (*MMSE*) (11), a set of 30 questions commonly use to check for cognitive impairment (thinking, communication, understanding and memory)

b. *Geriatric Depression Scale - short form* (*GDS*) (12,13), a self-report measure of depression in older adults.

2. Evaluation disabled:
   a. *Basic Activities of Daily Living* (*BADL*) (14), skills required to manage physical needs including personal hygiene or grooming, dressing, toileting, transferring or ambulating, and eating
   b. *Barthel Index* (15), used to measure performance in activities of daily living
   c. *Tinetti score* (16), a score to tested gait and balance
   d. *6-minute Walking Test* (*WT*) (17), measures the distance an individual is able to walk over a total of six minutes on a hard, flat surface.
3. Nutritional evaluation: Anthropometric indices, according to *European Prospective Investigation Into Cancer And Nutrition* (*EPIC*) (18).
4. Comorbidity assessment: *Cumulative Index Rating Scale* (*CIRS*) (13, 9), a tool used to measure multimorbidity.
5. Social Support Assessment (20), a 27-item questionnaire designed to measure perceptions of social support and satisfaction with that social support.
6. Sensorineural evaluation: Vision (21) and Hearing (22) deficiency.
7. Evaluation of urinary and fecal incontinence.
8. Quality of life evaluation: *EuroQol* (23), a simple questionnaire to assess quality of life (QoL).
9. Frailty assessment: *Frailty Staging System* (4, 24), an index of the severity of functional impairment , and *70-item CSHA frailty system* (25), a count of 70 clinical deficits.
10. Upper limb strength evaluation: *Hand Grip-Dynamometer* (26), an evaluation tool that's used to measure isometric grip force
11. Assessment of lower limb strength: Established Populations for the Epidemiologic Study of the Elderly *EPESE-Guralnik* (27), a battery that evaluates lower extremity functional performance using timed measures of standing balance, gait speed and lower extremity strength.
12. Physical Activity Evaluation: *Physical Activity Elderly Scale* (*PASE*) (28), score combines information on leisure, household and occupational activity.

Statistical analysis

The data were entered into a database and analyzed with the SPSS 13.0 program. The *Kolmogorov-Smirnov test* was used to evaluate the linearity of the data. Univariate analyses were used for the descriptive analysis of the data using the ANOVA to compare means for continuous data in the group of elderly people aged <75 years and ≥ 75 years and the X2 to compare discrete variables. The predictive role corrected for age and gender was assessed by logistic regression analysis of the various variables examined in the study on the presence of frailty. Frailty was considered a dichotomous variable: it was evaluated according to the *Fried scale* (10) when the score was ≥ 3; for the *Rockwood scale* (25) when the score was> 30, and in the *Lacks scale* (29) when the score was> 1. We evaluate the predictive role on the frailty of clinical (i.e., age, *CIRS-CIC-IDS*, *GDS*, *MMSE*, Lower limb strength, *PASE*) and biological variables (i.e., *C-reactive protein - CRP -*, *Homeostasis*

Model Assessment Insulin Resistance - HOMA-IR -, *albuminemia*, *ferritinemia*, *cholesterolemia*, *triglyceridemia*) using *Multiple linear regression* (according to the *STEPWISE modality*). We evaluate the predictive role of frailty (analyzed with the different scales, i.e., *Fried*, *Rockwood*, and *Lacks*) using multiple linear regression with the dependent variable the recovery from disability. We measure the recovery from disability using: *Delta Barthel* (*Barthel score in the follow-up - Barthel entry score*), the recovery of the *Tinetti score*, and the increase in the number of meters covered in the *6-minute Walking Test*, regardless of the role played by the other confounding variables (e.g., age, the strength of upper limbs, the strength of lower arts, *CIRS - CIC*, *CIRS - IDS*, *MMSE*, *GDS*, and *PASE*). We considered a p-value of 0.05 to be statistically significant.

Results

Patients' average age was 73.2 ± 5.6, 38.6% were over 75 years of age, mostly females (58.9%) with a further increase in older women (36.2% vs. 48.8%; p = 0.074). Hospitalization in 60.8% of patients was due to osteosynthesis for pertrochanteric intramedullary fractures, more frequently in the "young" elderly group of patients (aged up to 75 years, group A) than in the "elderly" patients (aged more than 75 years, group B, 67.5% vs. 50.0%; p = 0.013).

We collected patients' informations (Table 1) and we measured their clinical features (table 2).

The functional evaluation showed significant differences between the two groups in evaluating the strength measured in the lower and upper limbs. A clear difference emerges in the score of the *PASE scale*, which assesses the performance of physical activity in the month preceding the acute event, where a score of 49.5 ± 49.4 was observed for group B vs. 80.1 ± 52.6 in group A. A more scarce social support was evident in group B (6.5 ± 2.8 vs. 5.2 ± 2.2; p = 0.000) (Table 2). No difference was observed in the anthropometric variables (i.e., BMI, abdominal circumference, and waist/hip ratio) and weight loss. Likewise, there are no differences in the length of stay between the two groups (Table 2).

Table 3 shows no significant differences between the two groups in the measure of the recovery of the score at the *Barthel scale* (*Delta Barthel*), in the increase in the distance, traveled in meters, in the *Tinetti* and *EuroQol score*, indicative of all how the rehabilitation intervention conducted in the two groups has similar results. The table shows how the two groups' results are significant in the Barthel scale score's differences at the entrance and the discharge. Lower scores for group B indicate higher levels of disability and lower the number of meters traveled on the gait test, a lower score of *Tinetti's scale* on gait and balance, and a lower score in the *EuroQol*, indicating a lower performance capacity

Table 4 shows the results of the logistic regression analysis conducted to evaluate the association between the three types of frailty investigated, after correction by age and gender, with the *MMSE* and *GDS score*, the presence of visual and auditory impairment, weight loss, strength in the upper and lower limbs, *PASE score*, social support, *CIRS - CIC*, *CIRS - IDS*; increase in the score of the *Barthel scale*, the *Tinetti score* and the *EuroQol* as well as the increase in meters traveled between discharge and admission to hospitalization and length of stay.

The analysis showed that femoral fracture is predictive of frailty. At the same time, variables such as weight loss, the *Delta Walking Test*, and the *EuroQol Delta* are not associated with frailty, the strength measured in the lower limbs, the *PASE*, the *depressive symptoms* (GDS), the visual and auditory deficit, the social support and the comorbidity indexes measured with the *CIRS* (*CIC -IDS*), the *Barthel Delta,* and the *Tinetti Delta* and length of stay. The decay of cognitive functions is associated with both the frailty measured with the *Rockwood* and *Lacks scales*, but it is not with the *Fried scale*'s frailty. Strength measured in the upper limbs was predictive only on the *Rockwood frailty scale*. Multiple linear regression with variable dependent on frailty showed us how clinical variables such as *GDS* (Beta 0.435; p = 0.000) and strength in the lower limbs (Beta = -0.206; p = 0.016) are associated with the presence of frailty, according to *Fried*. The *GDS* (Beta (0.406; p = 0.000) and *CIRS - IDS* (Beta = -0.223; p = 0.013) are so with the frailty according to *Rockwood* and finally predictors of frailty measured with the *Lacks scale* are the *MMSE* (Beta = - 0.452; p = 0.000), the

strength measured in the lower limbs (Beta = -0.246; p = 0.002) and the levels of physical activity measured with the *PASE* (Beta = - 0.175; p = 0.033) (Table 5). As to the predictive role of clinical-biological variables, despite having low explaining variance values, we noted how clinical variables such as *CRP* are predictive of frailty regardless of the scale used.

When the recovery in terms of meters gained from the *6-minute Walking Test* was analyzed, we observed that frailty predicts the analysis and how variables such as the strength measured in the upper limbs, cognitive function, and depressive symptoms to independently predict the *Delta* at the *6-minute Walking Test* (*WT*).

Discussion

Our study shows that frailty is a high prevalence condition in patients with femoral fractures hospitalized in intensive rehabilitation after an acute event. About half of patients suffer from frailty. Predictive frailty measures are *strength measured in the lower limbs*, *PASE*, *depressive symptoms* (*GDS*), *visual and hearing impairment*, *social support*, and *comorbidity indexes* measured with *CIRS* (*CIC-IDS*). *CRP* is the predictive biological variable of frailty, measured with all the *Scores* evaluated.

The study also demonstrates that frailty is predictive of a rehabilitative result, highlighting how the recovery of the *Barthel* and *Tinetti score* on balance. *Physical Activity Elderly Scale* (*PASE*) is positively related to the level of frailty. Recovery is more significant for subjects burdened by higher levels of frailty investigated with the *Fried* and *Lacks scale*. Frailty also predicts the length of stay. The different measures of frailty used indicate different predictive power of the rehabilitation result.

The frailty measured with the *Fried* and *Lacks scales* showed an independent predictive role, which was not shown by the *Rockwood scale*. These results are in line with what has been reported in other contexts of population studies, where a predictive effect on the most significant mortality carried out by the frailty analyzed has been demonstrated by adding the disease conditions rather than the frailty assessed as a syndrome, i.e., in the absence of disease and as a result of a series of symptoms, the so-called "frailty phenotype" (30).

The failure to predict rehabilitation recovery with the *Rockwood* is because it considers chronic diseases with a high disabling load (25). It does not consider functional capacities like the *Fried scale* and even deficient domains like those evaluated in the *Lacks scale*.

We have highlighted that subjects with higher levels of frailty in the *Rockwood scale* do not benefit from functional recovery from the rehabilitation process.

Papers show how a bio-psycho-social approach in the elderly population and personalized rehabilitation programs improve functional outcomes and psychological conditions (31,32). Moreover, involving patients and caregivers could be a good approach to increasing patients' adherence (33,34), increasing their resilience, and upgrading functional recovery after hip fracture (35).

These results also suggest us some health policy considerations. Today, rehabilitation in Italy is paid per day of hospitalization based on a *Diagnosis-Related Group* (*DRG*), which refers to the pathology, in these patients, the femur's fracture.

The level of frailty conditioning the recovery of autonomy and, therefore, the consequent care load. A bio-psycho-social approach of frailty evaluation of population, could enhance public health facilitating integration of patients in the society.

Conclusion

We think that the approach based on the diagnosis and treatment of the individual disease should be radically changed to a culture and an assessment capacity of elderly persons. This assessment requires the indicators which characterize it: *comorbidity*, *psychological*, *cultural factors*, and *environmental health status*. Summarizing these conditions is defined by *frailty*, which becomes the most impacting variable in the recovery of autonomy.

Patient consent*:* All patients provided informed consent, and the research protocol was approved by the Ethical Board of our hospital (Ethics Committee of Azienda Socio Sanitaria Territoriale

Gaetano Pini-CTO, Milano, Italy) before the beginning of the study. The Ethical board confirmed that, as it was a retrospective observational study, the Board's authorization was unnecessary.

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