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Older People With Hip Fracture and IADL Disability Require Earlier Surgery

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Background. Hip fractures represent a major challenge for physicians as well as society as a whole. Both poor functional status and delay to surgery are well known risk factors for negative outcomes. We hypothesized that the timing of the operation is more important for frail older people than older people without functional limitations before fracture.

Methods. We performed a prospective multicenter cohort study on 806 consecutive patients, 75 years of age or older, admitted with a fragility hip fracture to three hospitals in the Emilia-Romagna Region (Italy). All three hospitals had a comanaged care model, and the patients were under the shared responsibility of an orthopedic surgeon and a geriatrician.

Results. Functional status assessed as instrumental activities of daily living was an important predictor of survival after 1 year from fracture. After adjusting for confounders, the hazard ratios per 1 point score of increase from 0 to 8 was 1.30 (95% confidence interval 1.19–1.42, p = .000). Time to surgery increased 1-year mortality in patients with a low instrumental activities of daily living score (hazard ratios per day of surgical delay 1.14, 95% confidence interval 1.06–1.22, p < .001) and intermediate instrumental activities of daily living score (hazard ratios 1.21, 95% confidence interval 1.09–1.34, p < .001) but was an insignificant risk factor in functionally independent patients (hazard ratios 1.05 95% confidence interval 0.79–1.41, p = .706).

Conclusions. Surgery delay is an independent factor for mortality in older patients after hip fracture but only for the frail older people with prefracture functional impairment. If our results are confirmed, a more intensive approach should be adopted for older people with hip fractures who have disabilities.

Key Words: Hip fracture—Mortality—Functional status—Frail elderly—Surgery delay.

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HIP fractures (HFs) represent a major challenge for physicians as well as society as a whole, given the high frequency of this condition, the excess of mortality rate within 1 year (1), and the high rate of disability in the survivors (2). Data suggest that negative outcomes occur mainly in the frail older people, who have functional limitations and limited physiological reserves with a reduced capacity to return to their functional independence and autonomy prior to HF (3,4). For these reasons, innovative care models have been developed and implemented to minimize in-hospital complications, streamline hospital care and provide early discharge with the main objectives of improving functional and clinical outcomes, and reducing direct and indirect health care costs (5).

The timing of surgery is an important marker of a patient's progress following a HF. It is now well established that a delay to surgery greater than 24–72 hours from admission is associated with an increased risk of complications and death irrespective of age and medical comorbidity (6–8). Therefore, guidelines recommend that surgery should be performed on the day of, or the day after, admission (9,10) and that it is necessary to maximize the proportion of medically fit patients receiving early surgery. Because the level of functional impairment affects the recovery of older people with HF, we hypothesized that the timing of the operation is more important for frail older people than for older people without functional limitations before fracture. The aim of this study was to examine the relationship between surgery delay and mortality in older people with HF, according to their level of functional impairment expressed as the ability to autonomously carry out instrumental activities of daily living (IADL).

Methods

Participants and Data Collection

We performed a prospective multicenter cohort study of consecutive patients, 75 years of age or older, admitted with a fragility HF between March 2008 and February 2009 to three hospitals of the Regional Health care System situated in different districts of the Emilia-Romagna Region (Italy). Patients whose fracture was due to secondary causes (bone metastatic cancer, Paget's disease of the bone) and who had sustained a fracture due to a major trauma or a previous fracture on the same hip were excluded. All three hospitals had a comanaged care model, described in details elsewhere (11), and the patients were under the shared responsibility of an orthopedic surgeon and a geriatrician. The study was a part of a wider survey supported by the Emilia-Romagna Regional Health Agency.

The geriatricians collected data on admission and during in-hospital stay through a standardized comprehensive geriatric assessment. Information recorded on admission included: age, gender, living arrangements (home, institution), type and mechanism of fracture, functional and cognitive status, comorbidity, and severity of illness. Prefracture functional status (2 weeks before) was measured for basic activities of daily living using the 6-item Katz Index (12) and for IADL using the 8-item Lawton index (13). Each item was logged as zero in case of total or partial assistance and as one in case of complete independence. Moreover, walking ability 2 weeks before the trauma was assessed using a scale developed in the European Standardized Audit for fractured proximal femur (14). Cognitive status was assessed by the Short Portable Mental Status Questionnaire (SPMSQ) (range 0–10 [15]). Thus, patients with a prior diagnosis of dementia or with an SPMSQ adjusted score of three or more errors were classified as having cognitive impairment. Medical burden and comorbidity were measured using the Charlson index (16). Severity of illness on admission was measured by the acute physiology score (score 0–71) of APACHE II (17). Time to surgery (from admission), type of surgery, and length of stay were collected from medical records. Time to surgery usually ranged from 0 to 10 days. The very few cases with a time to surgery longer than 10 days were all registered as 11 days for statistical purposes. Data on mortality up to 1 year after fracture were gathered from the public registries including Local Health Agency and Municipalities database.

Patients gave informed consent to participate in the study. When the participants were too confused to understand the informed consent process, proxy consent was obtained. This study was approved by the Ethics Committee of the Coordinating Center at the University Hospital Policlinico S. Orsola Malpighi Bologna, and notification was sent to other local Ethics Committees.

Data Handling and Analyses

On the base of their IADL score, HF patients were categorized into three subgroups according to their functional status. Patients unable to perform independently all or almost all of the items on the Lawton scale (IADL, score 0–2) were classified as group 1, whereas patients who were independent in all items or all but one (IADL, score 7–8) went into group 3 (high independence). The other patients (IADL, score 3–6) were classified as an intermediate level (group 2).

Categorical variables were expressed in percentages, and continuous variables were reported as mean ± standard deviation. One-way analysis of variance, Pearson's χ^2 test, and the Mann-Whitney U test were used to examine differences in patients' baseline characteristics or crude data between the groups.

The relationship between the IADL scale and mortality was calculated by linear regression analyses. To determine factors associated with 1-year mortality and the role of surgical delays—treated as a continuous variable—a Cox proportional hazards model was applied in order to control for confounding. All variables found to be related to the survival time with the level of p value < .1 were included in the multivariate analysis. To analyze the interaction between functional status and time to surgery, a Cox regression model was applied on the whole sample including the number of IADL abilities lost (range 0–8), the delay to surgery in days, and a derived variable from the product of the former two variables. Regression was also adjusted for age, gender, comorbidity, cognitive status, and acute physiology score.

Hazard ratios (HR) and 95% confidence intervals (CIs) were calculated. Significance was set at $p < .05$. Statistical analysis was performed with SPSS 18.0 for Windows (SPSS Inc., Chicago, IL).

Results

Table 1 shows the baseline characteristics and outcomes of the three functional status groups. As expected, given that patients had been categorized according to functional levels, all the baseline characteristics differed. Patients with a higher comorbidity or with a severe illness at admission, cognitive impairment, needing help to walk, and living in institutions are more frequent in the lower functional groups. Group 3 which included fully independent participants was also slightly but significantly younger (mean age 83 y vs 87 and 86 in group 1 and 2 respectively, $p < .001$) and with fewer male patients (20% vs 24 and 28 in group 1 and 2 respectively, $p = .039$). There is also an interesting trend in the distribution of different fracture types: intracapsular fractures are more common in independent participants and trochanteric fractures in disabled participants. As in other studies (18), patients with cervical fractures tend to be

Table 1. Baseline Characteristics of Patients and Outcomes by Functional Status Groups

Variables	Group 1 (IADL 0–2)	Group 2 (IADL 3–6)	Group 3 (IADL 7–8)	*p* Value	All
No.	391	237	178		806
Age (mean ± *SD*)	87.2 ± 5.4	85.5 ± 5.8	83.2 ± 5.3	<.001	85.8 ± 5.6
Sex (male %)	23.8	27.6	20.2	.039	23.7
Living in nursing home (%)	18.2	2.1	0	<.001	9.4
Fracture type (%)				.055	
Intracapsular	42.2	48.5	55.1		46.9
Trochanteric	51.2	42.6	37.6		46.0
Subtrochanteric	5.9	8.9	7.3		7.1
Charlson index (mean score ± *SD*)	2.8 ± 2.1	2.2 ± 1.8	1.7 ± 1.7	<.001	2.4 ± 2.0
APS (mean score ± *SD*)	3.4 ± 2.8	2.4 ± 2.4	2.2 ± 2.2	<.001	2.9 ± 2.6
Cognitive impairment (%)	91.9	48.5	28,1	<.001	62.2
Katz index (mean ± *SD*)	2.6 ± 1.8*	5.2 ± 1.1	5.7 ± 0.5	<.001	4.1 ± 2.0
Independent walk (%)	44,5	89.0	97.2	<.001	69.2
Bed or wheelchair ridden (%)	7.4	0.8	0	<.001	4.0
Time to surgery (mean days ± *SD*)	3.4 ± 2.1	3.3 ± 2.0	3.3 ± 1.8	.827	3.3 ± 2.0
Length of acute stay (mean days ± *SD*)	12.2 ± 5.4	13.6 ± 6.9	11.8 ± 4.6	.003	12.5 ± 5.4.
30-d mortality (%)	9.7	5.9	1.7	.002	6.8
1-y mortality (%)	43.7	24.1	7.3	<.001	29.9

Note: IADL = Instrumental Activities of Daily Living; APS = Acute Physiology Score of APACHE II.

slightly younger and healthier than those with trochanteric fractures.

The differences between the groups in respect of length of acute stay were very small, albeit statistically significant. Group 2 shows the highest mean in-hospital stay (13.5 d) and group 3 the lowest (11.8 d, $p = .003$).

The IADL score was an important predictor of survival after 1 year from fracture. Unadjusted HR per 1 point score of increase from 0 to 8 in a logistic regression model was 1.34 (95% CI 1.26–1.43, $p < .001$) and 1.30 (95% CI 1.19–1.42, $p < .001$) after controlling for age, gender, Charlson index, and cognitive impairment. A strong inverse relationship was found between the mean 1-year survival rate and the IADL score (Figure 1) with $R^2 = .83$, $p = .001$.

Therefore, both 30-day mortality and 1-year mortality showed marked and highly statistically significant differences among the three groups.

On the contrary, surgery delays showed no differences among the three groups, probably because system factors were more important than a patient's characteristics in determining the time of surgery. Figure 2 shows the distribution of the whole sample of patients according to time to surgery.

Predictors of 1-year mortality as derived by the multivariate Cox regression analysis in the three functional level groups are shown in Table 2. Among the basal characteristics, comorbidity and severity at admission were significant independent factors in all three groups, whereas male gender presented a significant risk factor in groups 1 and 2, Katz index only in group 1, and age in group 2.

Time to surgery increased the 1-year mortality risk by14% per day of surgical delay in group 1 (HR 1.16 95% CI 1.09–1.23, $p < .001$) and by 21% in group 2 (HR 1.2 95% CI 1.09–1.33, $p < .001$) but was an insignificant risk factor in group 3. The results of interaction analysis performed on the whole sample showed that time to surgery proved to be a significant risk factor (HR 1.16; 95% CI 1.02–1.33, $p = .028$), as did the number of IADL abilities lost (HR 1.23;

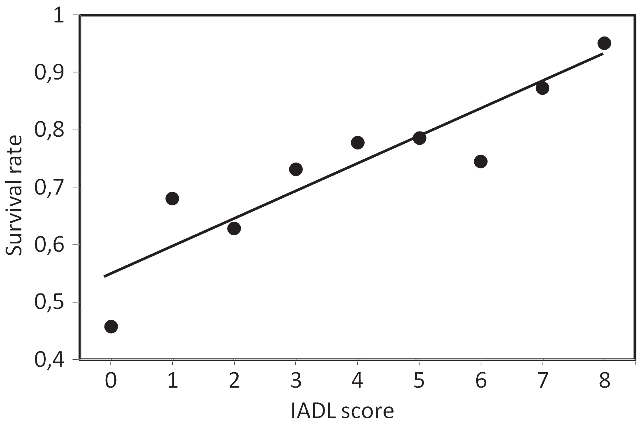

Figure 1. Distribution of the unadjusted survival rate of the patients after 1 year of follow-up according to Instrumental Activities of Daily Living (IADL) score.

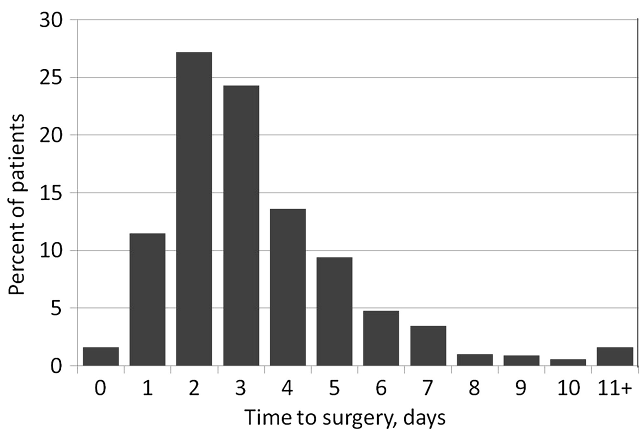

Figure 2. Distribution of the patients according to time to surgery.

Table 2. Predictor of Mortality At 1 Y in the Three Groups of Patients According to Multivariate Cox Regression Model

	Group 1 (n = 391), (IADL 0–2)		Group 2 (n = 237), (IADL 3–6)		Group 3 (n = 178), (IADL 7–8)	
Variables	HR (95% CI)	p Value	HR (95% CI)	p Value	HR (95% CI)	p Value
Age (per year of increase)	1.01 (0.97–1.04)	.510	1.07 (1.02–1.13)	.008	0.99 (0.86–1.15)	.929
Gender (male vs female)	2.19 (1.48–3.24)	<.001	2.69 (1.45–4.99)	.002	2.70 (0.73–9.94)	.136
Charlson index (per 1 score of increase)	1.08 (0.99–1.16)	.056	1.24 (1.08–1.43)	.003	1.35 (1.04–1.75)	.024
Cognitive impairment (yes vs no)	1.18 (0.56–2.48)	.663	0.93 (0.51–1.68)	.808	1.57 (0.48–5.25)	.459
Katz index (per 1 score of increase)	0.87 (0.78–0.96)	.009	0.86 (0.63–1.18)	.355	1.43 (0.32–6.32)	.640
APS (per 1 score of increase)	1.11 (1.04–1.19)	.003	1.11 (1.00–1.24)	.051	1.47 (1.17–1.83)	.001
Hospital (categorical)		.462		.609		.801
Time to surgery (per 1 day of increase)	1.14 (1.06–1.22)	<.001	1.21 (1.09–1.34)	<.001	1.05 (0.79–1.41)	.706

Note: IADL = Instrumental Activities of Daily Living; APS = Acute Physiology Score of APACHE II; HR = adjusted Hazard Ratio; CI = Confidence Interval. Hospital is a categorical variable reported only as total p value, since it is not significant.

95% CI 1.09–1.30, p = .001) but not the derived interaction variable (HR .99; 95% CI 0.98–1.02, p = .909).

Discussion

The effect of time to surgery after HF on mortality has been the focus of many investigations carried out over the past two decades. Two recent meta-analyses (6,7) concluded that surgery conducted within 48 hours is associated with lower mortality as well as with lower rates of certain postoperative complications. However, the evidence regarding timing and outcome in HF surgery comes largely from prospective or retrospective observational studies because randomized controlled trials on this topic are not very feasible or unethical (19). A larger review (8) of 52 published studies found conflicting results regarding increased mortality related to surgery delay, and the Authors emphasize that more careful methodological studies are necessary before definitive conclusions can be drawn and to establish whether some patients may benefit from early surgery more than others.

The current study demonstrated that surgery delay is a strong independent factor for mortality in older patients after HF but only in the frail older people with prefracture functional impairment. In prefracture fully independent participants, surgery delays do not seem to increase 1-year mortality.

Independence is usually measured in terms of functional ability and we categorized patients using the IADL score to capture the higher levels of abilities. Basic daily living activities such as bathing, dressing, going to the toilet, transferring, continence, and eating are actually not indicative of whether someone is able to live independently (20). On the contrary, participants able to perform the majority of IADL items without help certainly have a high level of independence and can be considered fully independent. In our cohort of unselected HF patients, 22% fall into this subgroup (IADL score ≥7). The interaction analysis between the IADL status and time to surgery proved not to be of any statistical significance. This result is not surprising because our data do not reveal a linear increase in the negative effect of delay to surgery in connection with the deterioration of the functional status of patients. Our data only seem to support the hypothesis that very healthy participants may suffer fewer detrimental effects from surgery delay than impaired participants, irrespective of the level of disability.

Prefracture functional status, along with other prefracture individual characteristics such as comorbidity, advanced age and male gender, is a well-established risk factor for mortality after HF (2,3,21–23). Probably because of its wide categorization in our study, the IADL score appeared to have a very strong relationship with mortality and provided an effective means to categorize patients with significantly different mortality risks. Looking at mortality risk factors within the functional status groups, comorbidity and severity at admission, as expected, were a significant independent risk factor in all three groups while delay to surgery seemed to affect mortality only in impaired participants.

These results are in contrast with the conclusions drawn by Shiga and colleagues (6) who found that delay to surgery is harmful, especially for low risk or young patients. However, a more recent meta-analysis (7) found that delay to surgery had a significant influence on mortality after adjustment for confounding preoperative factors regardless of health status. The differences in study method (metaregression analysis vs subgroup analysis) as well as the reasons for delays to surgery may explain the inconsistencies in the results. In particular, the timing of surgery is often influenced by system factors such as the availability of an operating theater or medical or nursing staff, on the one hand, or a patient's preoperative medical condition, on the other, such as the necessity to optimize a clinically unstable patient or the need of further investigation (24). In most of the studies included in Shiga's meta-analysis, for a low percentage of patients, intervention was postponed beyond 48 hours and this was mainly for medical reasons, whereas, in the current study, 61% of participants underwent surgery beyond 48 hours and the delays seemed to be prevalently due to system factors. In fact, no differences in surgical delays have been found between the functional groups and no significant correlations were established between delays and comorbidity or severity at admission.

Currently, there are still conflicting opinions on which patients should be considered medically fit to undergo surgery as soon as possible and which have conditions that ought to be investigated and treated before surgery. McLaughlin and colleagues (25) defined 11 classes of preoperative clinical abnormalities (major and minor) that were associated with poor postoperative outcomes in a group of HF patients. They concluded that only major clinical abnormalities should be corrected (if possible) prior to surgery. Correction of major clinical abnormalities before surgery improved the adjusted survival but postponement without the correction of a medical abnormality before surgery was associated with a significantly lower adjusted survival. Therefore, possible benefits of postponement need to be weighed against prolonged discomfort for the patient and the possibility of the development of other complications (26) such as pulmonary embolism, cardiac events, major infection, and renal failure (27).

On the basis of our data, the harmful effects of prolonged immobilization related to delays to surgery occur mainly in the frail older people. These results are in agreement with the concept expressed by Gill and colleagues (28), who reported that the presence of physical frailty increased the likelihood of developing new or worsening disability after intervening illnesses and injuries. For example, the absolute risk of transitioning from no disability to mild disability within 1 month of hospitalization for frail individuals was one of three and less than 5% for nonfrail individuals.

Our results have clinical implications because they support the concept that older people with HF and preexisting disabilities need a more aggressive intervention than those without disabilities. In particular, a quicker intervention and a rapid optimization of clinical instability if present are required. The timing of treatment for patients sustaining fractures of the proximal femur is a big challenge for a health care system. It requires both a coordination between several disciplines and the availability of appropriate theater space with trained staff (29,30). Important features of the new care model include multidimensional evaluation that has already been shown to improve outcomes in the frail older people hospitalized in general hospital settings (31) and collaboration between orthopedic and geriatric staff who take action in the preoperative phase to optimize patients before surgery at the same time avoiding nonessential investigation (29,32) in order to reduce delay to surgery.

The present study has several limitations. First of all, this is only an observational study and although the analyses were adjusted for confounding variables, the results must be assessed with caution. At the same time, it should be emphasized that randomized trials on time to surgery are very difficult to carry out and unavoidably run the risk of selection bias, usually by excluding just participants with dementia or frailty (33). The real-world unselected samples with a high rate of comorbid participants are a strength of this study.

A second limitation is the lack of data on the real reasons for surgical delays. Only indirect data led to the attribution of much of surgical delay to system factors. Therefore, other studies are needed to reinforce our results by focusing on the effect of surgical delay in HF elderly subgroups with different prefracture functional statuses or comorbidities. However, if our results are confirmed, the common practice of operating first on patients with no medical problems and a high prefracture level of independence should change and a more intensive approach should be adopted for the frail HF older people.

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