A short comprehensive assessment to predict outcome of elderly patients after hip fracture

Sophie Pautex[1,2], Marie-Claire Jacques[1,2], Aditya Sant[1,2], François Herrmann[2], and Thierry Chevalley[1,2]
Geriatric Evaluation Unit[1], Department of Rehabilitation and Geriatrics[2], University Hospitals of Geneva, Switzerland

ABSTRACT. ***Background and aims:*** *Hip fractures result in significant functional impairment and a high rate of institutionalization. The aim of our study was to evaluate in patients with a recent hip fracture the contribution of a short (15-min) comprehensive assessment to predict the length of stay and the risk of discharge to a nursing home.* ***Methods:*** *Prospective clinical study conducted in a rehabilitation ward of the Geriatric Hospital. Functional assessment included basic activities of daily living (BADL), cognitive status (MMSE) and a 4-item geriatric depression scale (Mini-GDS). Information on demographic data, living situation, diagnosis and illness burden was also collected.* ***Results:*** *The mean age of the 86 patients (67W/19M) was 84.2±6.8 years. In a multiple regression analysis, the length of stay in a geriatric hospital was significantly associated with both marital status (living alone) (p=0.035) and the intervention of a caregiver on a regular basis (p=0.036), but not with Charlson's comorbidity score. In a logistic regression model, adjusted for age, gender, marital status, intervention of a caregiver on a regular basis, BADL, Mini-GDS and Charlson's comorbidity score, the only independent predictor of nursing home admission was a MMSE <24, which increased by 10.7-fold (2.2-50.9) the risk of being admitted to a nursing home (p=0.003).* ***Conclusions:*** *A short comprehensive assessment completed a few days after a hip fracture is useful in predicting length of stay and risk of nursing home admission.*
(Aging Clin Exp Res 2005; 17: 116-120)

INTRODUCTION

Hip fractures represent a leading cause of disability and mortality in the elderly, and result in significant functional impairment and a high rate of institutionalization. Functional status, defined as everyday behavior necessary for maintaining a daily life-style, and encompassing areas of psychiatric, cognitive and social functioning, is described to be a stronger predictor of the hospital outcome of elderly patients than diagnosis on admission, diagnosis-related group, and standard indices of illness burden (1-4). After hip fracture, a large number of studies have tried to identify predictors of recovery ability at one, three, six and twelve months after discharge (5-8). Nevertheless, most of them used a combination of factors relating to patients (age, sex, living condition, type of fracture), treatment (anesthesia, surgery) and rehabilitation. Other studies measured more specifically the relation between cognitive status and the success of rehabilitation after hip fracture (9-11). The aim of this study was to evaluate, in patients with a recent hip fracture, whether a very short assessment tool (15 minutes) including only functional factors such as activities of daily living, cognitive impairment, assessment of depression along with demographic data, could predict the length of stay in a geriatric rehabilitation unit and the risk of admission to a nursing home.

METHODS

Over a period of 17 months (January 1999-June 2000), 133 patients 65 years or older, hospitalized for hip fracture in the orthopedic clinic, were transferred to the rehabilitation ward of the Geriatric Hospital in Geneva. Clinical assessments were performed before discharge of patients to the Geriatric Hospital by four physicians, experts in geriatrics, working in the Geriatric Evaluation Unit at the main University Hospital in Geneva. A short assessment tool (about 15 minutes) was completed for each patient. Collected data included demographic information, current living situation, main medical diagnoses, and functional assessment. Illness burden was measured by Charlson's comorbidity score (12). Functional assessment included basic activities of daily living (BADL), cognitive status and a geriatric depression scale. BADL im-

Key words: Elderly, geriatric assessment, hip fracture, institutionalization, length of stay.

Correspondence: S. Pautex, MD, CESCO, Department of Rehabilitation and Geriatrics, ch. de la Savonnière 11, CH-1245 Collonge-Bellerive, Switzerland.
E-mail: sophie.pautex@hcuge.ch

Received October 13, 2003; accepted in revised form September 3, 2004.

pairment was defined as needing physical assistance before admission in performing at least one of the six basic skills (feeding, bathing, dressing, toileting, transferring, urinary continence) by patient self-report (13). This definition threshold has been used previously (2). When the Mini Mental State Examination (MMSE) score was lower than 24, BADL assessment was confirmed by a family member or a caregiver. The MMSE was employed to assess cognitive status and a cut-off score of 24 was used to differentiate cognitively intact (≥24) from cognitively impaired patients (<24) (14). Screening for depression was performed using a 4-item Geriatric Depression Scale (Mini-GDS) validated in French (15). Patients were considered at risk of depression if the score was equal to or greater than one. The Body Mass Index (BMI) of patients was not recorded, because weight is not easily measurable in elderly patients with hip fractures. Two outcomes were measured: length of stay in the Geriatric Hospital, and the risk of nursing home admission after hospitalization. Exclusion criteria were severe cognitive impairment (MMSE<11) (n=42), aphasia (n=2), and severe sensory impairment (n=3). Thus, 47 subjects were ineligible. Compared with that of patients included in the study, the mean age of excluded patients was similar (84.0±6.7 *vs* 84.2±6.8, $p>0.05$); their mean MMSE score was significantly lower (5.5±4.5 *vs* 22.9±5.5, $p<0.001$); 13 *vs* 7% ($p>0.05$) were living in a nursing home before fracture; 39 *vs* 26% ($p>0.05$) were discharged to a nursing home and five died.

Statistical analysis: Student's *t*-test was used to compare mean values between two different groups. The Chi-square test was used to compare the proportions of patients institutionalized. Multiple linear regression analysis was employed to determine predictors of length of stay in the Geriatric Hospital, after adjustment for the other variables. This model included gender, current living situation, intervention of a caregiver on a regular basis, MMSE (<24), Mini-GDS (≥1), BADL (>1), age and Charlson's comorbidity score measured on a continuum. Logistic regression was used to predict the risk of nursing home admission, after adjustment for the same variables listed above. Patients living in nursing homes before admission were excluded from this analysis. A logarithmic transformation of length of stay was carried out to achieve better agreement with normal distribution.

RESULTS

The mean age of the 86 consecutively-included hip fracture patients (67 women, 19 men) was 84.2±6.8 years. They were evaluated on average 8.3±2.9 days after surgery, corresponding to 4.2±2.9 days prior to their transfer to the rehabilitation ward of the Geriatric Hospital. Mean Charlson comorbidity score was 1.6±1.2 (range 1-6). Table 1 lists patients' demographic and functional characteristics. Most patients lived at home (93%) and alone (64%), 36% had a caregiver on a regular basis, 42% were impaired in at least one BADL, 44% had impaired cognitive function, and 23% suffered from possible depression. Before their transfer to the geriatric rehabilitation ward, the mean length of stay in the orthopedic ward was 13.3±5.5 days. After geriatric rehabilitation, 21 patients previously living at home were discharged to nursing homes. The length of stay of these patients was significantly longer than those returning home (79.2±47.9 *vs* 49.9±27.7 days, $p<0.05$). Patients with BADL or cognitive impairment were at significantly higher risk of being institutionalized (36 *vs* 19%, $p<0.05$ and 44 *vs*

Table 1 - *Patients' characteristics.*

	n (%)	Age mean±SD	Living at home n (%)	Living alone n* (%)	Regular caregiver n* (%)	LOS [days] rehabilitation mean±SD (median)	Discharge to nursing home* n (%)
All patients	86	84.2±6.8	80 (93)	51 (64)	29 (36)	57.0±35.4 (48.5)	21 (26)
Basic activities of daily living							
dependent ≥1 BADL	36 (42)	85.3±6.8	33 (92)	18 (55)	22 (67)	55.9±32.2 (44.5)	12 (36)
independent BADL	50 (58)	83.4±6.7	47 (94)	33 (70)	7 (15)[&]	57.7±37.8 (54.0)	9 (19)[#]
Cognitive function (MMSE)							
MMSE <24	38 (44)	87.5±5.0	36 (94)	19 (52)	20 (56)	65.1±38.2 (56.0)	16 (44)
MMSE ≥24	48 (56)	81.7±6.9[#]	44 (92)	32 (72)	9 (20)[&]	50.6±32.0 (44.5)	5 (11)[&]
Depression							
Mini-GDS ≥1	20 (23)	84.4±5.8	17 (85)	10 (58)	8 (47)	64.5±45.4 (47.5)	5 (29)
Mini-GDS <1	66 (77)	84.2±7.1	63 (95)	41 (65)	21 (33)	54.7±31.9 (48.5)	16 (25)
Discharge*							
home*	59 (74)	83.0±7.1				49.9±27.7 (45.0)	
nursing home*	21 (26)	86.3±4.9				79.2±47.9[#] (78.0)	

*6 patients living in nursing homes before admission were excluded.
[#]$p<0.05$, [&]$p<0.001$.

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Table 2 - *Predictors of hospitalization length in rehabilitation unit#.*

	Crude β (95% CI)	p	Adjusted β (95% CI)	p
Sex	0.03 (–0.29-0.34)	0.872	–0.17 (–0.49-0.15)	0.298
Age+	0.02 (0.00-0.04)	0.068	0.01 (–0.02-0.03)	0.639
Living alone	0.22 (–0.05-0.49)	0.105	0.30 (0.02-0.59)	0.035
Regular caregiver	0.31 (0.05-0.58)	0.022	0.36 (0.02-0.70)	0.036
BADL(>1)	–0.02 (–0.29-0.25)	0.870	–0.25 (–0.56-0.06)	0.107
MMSE(<24)	0.27 (0.02-0.53)	0.038	0.24 (–0.07-0.56)	0.124
4-item GDS(≥1)	0.14 (–0.19-0.46)	0.403	0.18 (–0.14-0.50)	0.271
Charlson+	0.02 (–0.09-0.13)	0.696	0.01 (–0.11-0.11)	0.970

#To achieve better agreement with normal distribution, a logarithmic transformation of this variable was performed.
+Continuous variables. β=regression coefficient.

11%, $p<0.001$, respectively). Cognitively impaired patients (MMSE score <24), who were significantly older, stayed longer than cognitively intact patients. The Mini-GDS score predicted neither the length of stay, nor the nursing home admission risk.

In a multiple regression model, length of stay in a Geriatric Hospital was significantly associated with marital status (living alone) ($p=0.035$) and with the intervention of a caregiver on a regular basis ($p=0.036$) (Table 2). Instead, gender, age, cognitive status, Mini-GDS and Charlson's comorbidity scores were not predictive of length of stay in this model. The total BADL score was also not predictive of length of stay. The only specific BADL that was significantly associated with length of stay in this model was urinary incontinence ($p=0.027$).

In a logistic regression model, adjusted for age, gender, marital status, intervention of a caregiver on a regular basis, BADL, Mini-GDS and Charlson's comorbidity scores, the only independent predictor of nursing home admission was a MMSE <24, which increased by 10.7-fold (2.2-50.9) the risk of being discharged to a nursing home ($p=0.003$) (Table 3). Dependency in BADL almost reached significance ($p=0.053$). A sub-analysis of the six specific BADL demonstrated that washing was the only specific BADL that increased by 5.9-fold (1.2-29.8) the risk of being discharged to a nursing home ($p=0.030$). Age, marital condition, intervention of a caregiver on a regular basis, and possible detection of depression were not statistically associated with the risk of nursing home admission. This model correctly classified 81.3% (65/80) of the patients, and had a sensitivity of 47.6% and a specificity of 93.2% for predicting the risk of nursing home admission, with an area under the curve (ROC) of 0.80.

When lowering the cut-off of the MMSE score down to 22, the risk of being institutionalized after geriatric rehabilitation as compared with patients with a MMSE score ≥22 ($p<0.001$) increased by 19.6-fold (3.9-98.0) for those with a MMSE <22. With this MMSE threshold set at 22, the new model for predicting nursing home admission correctly classified 85% (68/80) of the patients, showed a sensitivity of 61.9%, and a specificity of 93.2%, and a ROC of 0.85.

DISCUSSION

In these elderly hip-fractured patients, our study showed that the most important factor, besides the social factor

Table 3 - *Predictors of nursing home admission.*

	Crude OR	p	Adjusted OR	p
Sex	2.23 (0.58-8.61)	0.244	3.95 (0.72-21.74)	0.114
Age+	1.08 (1.00-1.18)	0.060	1.01 (0.91-1.13)	0.844
Living alone	1.19 (0.42-3.40)	0.746	1.54 (0.41-5.77)	0.526
Regular caregiver	1.46 (0.53-4.05)	0.464	0.28 (0.06-1.41)	0.123
BADL(>1)	2.41 (0.87-6.66)	0.089	4.49 (0.98-20.59)	0.053
MMSE(<24)	6.24 (2.00-19.50)	0.002	10.66 (2.23-50.87)	0.003
4-item GDS(≥1)	1.22 (0.37-4.10)	0.739	1.45 (0.31-6.73)	0.638
Charlson+	0.89 (0.58-1.39)	0.619	0.73 (0.43-1.23)	0.234

+Continuous variable.

(living at home alone), in predicting both length of stay in a geriatric rehabilitation unit and the risk of nursing home admission was cognitive status (MMSE score). Instead, Charlson's comorbidity score was neither associated with length of stay in a geriatric rehabilitation unit nor with the risk of being discharged to a nursing home. Unlike previous studies which aimed at identifying predictors of recovery ability at one, three and six months after hip fracture, based on a combination of factors not only related to the patient (age, gender, living condition, type of fracture) but also to treatment (anesthesia, surgery) and rehabilitation, the aim of our study was to measure whether a very short form of comprehensive assessment, completed in about 15 minutes, helped to predict – already before admission to the geriatric rehabilitation unit – the length of stay and risk of discharge to a nursing home (5-8, 16-18). A quarter of the patients admitted to the geriatric rehabilitation unit and living at home before hip fracture were institutionalized, since they did not recover their pre-fracture functional level. Previous studies have reported the same proportion of hip fracture patients (18-31%) for whom institutionalization was required in 12 months following fracture (5, 7, 8, 19, 20). For the prediction of nursing home admission, the best cut-off score was MMSE <22 at admission, which correctly classified 68 out of 80 patients. In 224 patients admitted for rehabilitation after hip fracture, Heruti et al. also reported a strong association between cognitive status at admission and the success of rehabilitation, evaluated as functional outcome and length of stay in a rehabilitation unit (10). Other authors have also demonstrated that cognitive impairment is a marker of poor prognosis in terms of ambulatory level, length of stay, and discharge to nursing home (1, 9, 11, 21).

Our patients with a possible diagnosis of depression, based on the Mini-GDS score calculated a few days before their admission to the geriatric rehabilitation unit, did not have a significantly higher risk of being institutionalized in the 2 months after fracture, or a significantly longer length of stay in the rehabilitation unit. These findings do not fit other studies which demonstrate the importance of mental health for recovery after hip fracture (7, 22-24). They used more complete assessment tools like the Center for Epidemiological Studies depression scale. A short assessment tool like the Mini-GDS may not be accurate enough to predict the outcome of patients after hip fracture.

A significantly higher proportion of patients with impaired BADL before fracture, as assessed retrospectively by the patient, was institutionalized. In the predictive regression models, impaired BADL before fracture was not associated with increased length of stay in the geriatric rehabilitation unit. However, the risk of being discharged to a nursing home was almost significantly increased 4.5-fold in the case of impaired BADL. In a prospective study of 232 consecutive patients with hip fracture, with a mean age of 81 years and living independently before admission, Svensson et al. demonstrated that the most important factors predicting independent living at one year were pre-injury function in activities of daily living, absence of other medical conditions which would impair rehabilitation, and intact cognitive function (8). In another prospective study, among various parameters like ADL, Young et al. examined fracture severity and surgical procedure as predictors of functional recovery at 2, 6 and 12 months after hospital discharge in 294 community-dwelling older people with subcapital hip fractures (16). Poor pre-fracture physical and instrumental activities of daily living (IADL) were predictive of poor BADL and IADL functional recovery at 2, 6 and 12 months after hospital discharge. Pre-fracture unsteady gait, length of stay, and discharge to an institution were also significantly associated with impaired IADL. In our short form of functional assessment, BADL were obtained from the patients themselves, if the MMSE was greater than 24. This retrospective assessment of physical functioning before fracture may have overestimated the real performance of our patients (4).

The illness burden score, like Charlson's comorbidity score used here, was not significantly associated with length of stay in a geriatric rehabilitation unit, nor with the risk of nursing home admission. These results are comparable to those derived from other studies on elderly patients in medical wards, which concluded that functional status, living location, and decreased mental status are stronger predictors of hospital outcomes than diagnosis on admission, diagnosis-related group, and standard indices of illness burden (1-4). In studies on orthopedic patients, the value of comorbidity scores was more controversial and was also related to the scale used (5-7, 20, 25).

Although the characteristics of patients included in this study were similar in terms of gender, age, living conditions and cognitive status to those reported in other studies on hip fracture patients (6, 7, 26), it has some limitations. The first is the small size of the sample, which does not allow formal validation of the predictive value of our short comprehensive assessment tool on an independent set of patients. The second limitation is possible overestimation by patients of their real level of performance in BADL before fracture. The third is that the risk of nursing home admission was measured at the time of discharge from the geriatric rehabilitation unit (median of 50 days) and not 6 or 12 months after fracture, as most often reported in previous studies.

Patients with functional impairment, particularly cognitive failure, had a significantly higher risk of institutionalization. The completion of a short comprehensive assessment form at the time of admission to the geriatric rehabilitation unit allowed us to identify patients in the category of higher risk of institutionalization, and therefore

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to anticipate their enrolment on long waiting-lists for nursing home admission. Nevertheless, even for these patients, for whom a nursing home placement was envisaged at the time of admission to the geriatric rehabilitation unit, it is crucial to their functional recovery not to exclude them from rehabilitation programs. Indeed, while cognitive impairment is considered to be a significant prognostic factor for rehabilitation, several studies have demonstrated that even cognitively impaired patients who take part in adapted re-education programs after hip fracture, can improve their mobility (11, 27, 28). Wells et al, who have recently performed an extensive literature review, recommended that elderly subjects with hip fracture be screened for nutrition, cognition, and depression (29, 30).

CONCLUSIONS

Our study shows that a short comprehensive assessment of elderly patients a few days after hip fracture may help to identify – already before their admission to a geriatric rehabilitation unit – those at risk of nursing home admission, and to predict their length of stay.

REFERENCES

1. Fields SD, MacKenzie CR, Charlson ME, et al. Cognitive impairment. Can it predict the course of hospitalized patients? J Am Geriatr Soc 1986; 34: 579-85.
2. Inouye SK, Wagner DR, Acampora D, et al. A predictive index for functional decline in hospitalized elderly medical patients. J Gen Intern Med 1993; 8: 645-52.
3. Narain P, Rubenstein LZ, Wieland GD, et al. Predictors of immediate and 6-month outcomes in hospitalized elderly patients. The importance of functional status. J Am Geriatr Soc 1988; 36: 775-83.
4. Sager MA, Franke T, Inouye SK, et al. Functional outcomes of acute medical illness and hospitalization in older persons. Arch Intern Med 1996; 156: 645-52.
5. Ceder L, Svensson K, Thorngren KG. Statistical prediction of rehabilitation in elderly patients with hip fractures. Clin Orthop 1980; 52: 185-90.
6. Koval KJ, Skovron ML, Polatsch D, et al. Dependency after hip fracture in geriatric patients: a study of predictive factors. J Orthop Trauma 1996; 10: 531-5.
7. Magaziner J, Simonsick EM, Kashner TM, et al. Predictors of functional recovery one year following hospital discharge for hip fracture: a prospective study. J Gerontol 1990; 45: M101-7.
8. Svensson O, Stromberg L, Ohlen G, et al. Prediction of the outcome after hip fracture in elderly patients. J Bone Joint Surg Br 1996; 78: 115-8.
9. Matsueda M, Ishii Y. The relationship between dementia score and ambulatory level after hip fracture in the elderly. Am J Orthop 2000; 29: 691-3.
10. Heruti RJ, Lusky A, Barell V, et al. Cognitive status at admission: does it affect the rehabilitation outcome of elderly patients with hip fracture? Arch Phys Med Rehabil 1999; 80: 432-6.
11. Huusko TM, Karppi P, Avikainen V, et al. Randomised, clinically controlled trial of intensive geriatric rehabilitation in patients with hip fracture: subgroup analysis of patients with dementia. BMJ 2000; 321: 1107-11.
12. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987; 40: 373-83.
13. Katz S, Ford AB, Moskowitz RW, Jacson BA, Jaffe MW. Studies of illness in the aged: the index of ADL, a standardized measure of biological and psychosocial function. JAMA 1963; 185: 914-9.
14. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12: 189-98.
15. Clement JP, Nassif RF, Leger JM, et al. Development and contribution to the validation of a brief French version of the Yesavage Geriatric Depression Scale. Encephale 1997; 23: 91-9.
16. Young Y, Brant L, German P, et al. A longitudinal examination of functional recovery among older people with subcapital hip fractures. J Am Geriatr Soc 1997; 45: 288-94.
17. Zuckerman JD, Koval KJ, Aharonoff GB, et al. A functional recovery score for elderly hip fracture patients: II. Validity and reliability. J Orthop Trauma 2000; 14: 26-30.
18. Michel JP, Klopfenstein C, Hoffmeyer P, Stern R, Grab B. Hip fracture surgery: is the pre-operative American Society of Anesthesiologists (ASA) score a predictor of functional outcome? Aging Clin Exp Res 2002; 14: 389-94.
19. March LM, Cameron ID, Cumming RG, et al. Mortality and morbidity after hip fracture: can evidence based clinical pathways make a difference? J Rheumatol 2000; 27: 2227-31.
20. Schurch MA, Rizzoli R, Mermillod B, et al. A prospective study on socioeconomic aspects of fracture of the proximal femur. J Bone Miner Res 1996; 11: 1935-42.
21. Van der Sluijs JA, Walenkamp GH. How predictable is rehabilitation after hip fracture? A prospective study of 134 patients. Acta Orthop Scand 1991; 62: 567-72.
22. Cobey JC, Cobey JH, Conant L, et al. Indicators of recovery from fractures of the hip. Clin Orthop 1976; 117: 258-62.
23. Mossey JM, Mutran E, Knott K, et al. Determinants of recovery 12 months after hip fracture: the importance of psychosocial factors. Am J Public Health 1989; 79: 279-86.
24. Hannan EL, Magaziner J, Wang JJ, et al. Mortality and locomotion 6 months after hospitalization for hip fracture: risk factors and risk-adjusted hospital outcomes. JAMA 2001; 285: 2736-42.
25. Kempen GI, Sanderman R, Scaf-Klomp W, et al. The role of depressive symptoms in recovery from injuries to the extremities in older persons. A prospective study. Int J Geriatr Psychiatry 2003; 18: 14-22.
26. Eastwood EA, Magaziner J, Wang J, et al. Patients with hip fracture: subgroups and their outcomes. J Am Geriatr Soc 2002; 50: 1240-9.
27. Kennie DC, Reid J, Richardson IR, et al. Effectiveness of geriatric rehabilitative care after fractures of the proximal femur in elderly women: a randomized clinical trial. BMJ 1988; 297: 1083-6.
28. Goldstein FC, Strasser DC, Woodard JL, et al. Functional outcome of cognitively impaired hip fracture patients on a geriatric rehabilitation unit. J Am Geriatr Soc 1997; 45: 35-42.
29. Wells JL, Seabrook JA, Stolee P, Borrie MJ, Knoefel F. State of the art in geriatric rehabilitation. Part I: review of frailty and comprehensive geriatric assessment. Arch Phys Med Rehabil 2003; 84: 890-7.
30. Wells JL, Seabrook JA, Stolee P, Borrie MJ, Knoefel F. State of the art in geriatric rehabilitation. Part II: clinical challenges. Arch Phys Med Rehabil 2003; 84: 898-903.