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Elderly Patients With Cognitive Impairment Have a High Risk for Functional Decline During Hospitalization: The GIFA Study

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Background. We tested the hypothesis that cognitive impairment upon admission (CIA) and cognitive decline (CD) during hospitalization are associated with an increased risk for functional decline (FD) in older inpatients.

Methods. The Italian Group of Pharmacoepidemiology in the Elderly (Gruppo Italiano di Farmacoepidemiologia nell'Anziano, GIFA) project was a multicenter survey of 9061 older patients admitted to Italian hospitals between 1991 and 1997. CIA was defined as a Hodkinson Abbreviated Mental Test score <7 on admission. The percentage of participants who developed FD, defined as loss of the ability to perform without help one or more activities of daily living between admission and discharge, was compared in patients who did and did not have CIA, and between those who lost at least one point in Hodkinson Abbreviated Mental Test score (CD) and those who did not.

Results. Mean age was 77.4 years, and women represented 52.3% of the sample. CIA was present in 21.0% of the patients. During hospitalization, 176 patients (1.9%) experienced FD (4% of those with CIA vs 1.3% of those without CIA). In multivariate analysis, CIA was an important risk factor for FD (odds ratio 2.4; 95% confidence interval, 1.7–3.5; $p < .001$), independent of age, gender, comorbidity, polypharmacy, and disability on admission. CD occurred in 3.7% of the sample and was strongly associated with an increased risk for FD (odds ratio 16.0; 95% confidence interval, 10.8–23.6; $p < .001$).

Conclusions. Elderly patients with CIA have a higher risk for FD. New strategies should be implemented to prevent FD in patients with cognitive impairment, who account for a high percentage of older persons who are admitted to hospitals.

OLDER persons who are admitted to the hospital often experience functional decline (FD) (1–3), which in many instances occurs during the hospitalization period, leading to worsening health status and more severe disability at discharge (3). Because with appropriate interventions some FD during hospitalization can be prevented (1,4), the population most likely to benefit from intervention should be identified. Several factors have been associated with the risk of FD in hospitalized older patients, such as older age, preexisting disability, depressive symptoms, and delirium (3,5,6).

In some studies cognitive impairment upon admission (CIA), which is common among older inpatients (7,8), was associated with a higher risk of FD (6,9) and with a lower probability of functional recovery (10). However, previous studies were performed in the United States, where the health care system is different from the socialized system of European countries; therefore, their results might not be generalizable to the older European population. Moreover, the majority of these studies neither evaluated the effect of cognitive changes during hospitalization on the risk of FD nor took into account some potentially important confounders such as body mass index (BMI) and polypharmacy.

Using data from the GIFA project, we tested the hypothesis that CIA and cognitive decline (CD) during hospital stay were associated with a higher risk of FD in activities of daily living (ADL) during hospitalization in a large sample of elderly patients admitted to Italian hospitals.

Methods

Study Population and Data Collection

The Italian Group of Pharmacoepidemiology in the Elderly (Gruppo Italiano di Farmacoepidemiologia nell'Anziano, GIFA) is a multicenter observational study. The methods were described in detail elsewhere (11). In the analysis presented here, we considered all patients consecutively admitted to the participating hospitals during four surveys between 1991 and 1997. Trained physicians collected all data using standardized instruments. Demographic, social, and clinical data were collected on admission and updated daily until discharge. Medical diagnoses were coded using the International Classification of Diseases, Ninth Revision (ICD-9). Because we were interested in older patients, we excluded patients <65 years. Patients who died, those with missing ADL data, those with a length of stay >90 days, or those with a diagnosis of mental retardation were excluded. Moreover, we excluded patients who had an admission ADL score equal to 0, because they cannot undergo FD.

Table 1. Hodkinson Abbreviated Mental Test

1. How old are you?
2. What is the time?
3. Can you repeat the address I gave you? (Address for recall at end of test; this should be repeated by the patient to ensure it has been heard correctly: 37 Garibaldi Street*)
4. What year are we in?
5. What is the name of this place?
6. Do you recognize these people (recognition of two persons, e.g., doctors, nurse)
7. When is your birthday?
8. When did the First World War begin?
9. What is the name of the President of the Italian Republic?†
10. Please count backwards 20 to 1.
(Each correct answer scores one)

Note: *In the original version, the sentence ''42 West Street'' is present instead of ''37 Garibaldi Street.''

†In the original version, the question ''name of present Monarch'' appears instead of ''name of the President.''

From an original sample of 17,552 patients, 9061 patients (51.6%) were included in this study. Many patients (4561, 26%) were not eligible because they were <65 years. Reasons for excluding older adults were: death during hospitalization (928, 5.3%), admission ADL score equal to 0 (2171, 12.3%), missing functional data (734, 4.2%), length of stay >90 days (93, 0.005%), and mental retardation (4).

Evaluation of Cognitive Status

Our conceptual exposure measure was the presence of CIA, defined as a Hodkinson Abbreviated Mental Test (HAMT) score of 6 or less on admission. The HAMT includes 10 questions (Table 1) (12) that are asked without providing any comment or suggestion. The total score can range from 0 (no correct answer) to 10 (all correct answers). The HAMT, administered on admission and on the day before discharge, has been validated in the Italian language. A score of 6 or less has the best combination of sensitivity and specificity for the identification of cognitive impairment (13). This cutoff has been already used to identify cognitive impairment in older persons (14).

Evaluation of Functional Status

The main outcome measure was FD during hospitalization, defined as a loss of at least one ADL between admission and discharge. Functional status was assessed on admission and on the day before discharge based on self-report or proxy report, when the patient was unable to provide this information. We considered six ADLs (transferring from bed to chair, walking, eating, dressing, toileting, and bathing) and assigned a score of 1 if the patient was able to perform the activity without help and a score of 0 if the patient needed help. The total score ranged from 0 (total dependence) to 6 (total independence). ADL impairment on admission was defined as needing help in at least one activity.

Potential Confounders

Delirium was diagnosed according to Diagnostic and Statistical Manual-IIIR criteria (15). Comorbidity was measured using the Charlson index (16). The score was categorized into three classes (0, 1, and ≥2) representing increasing levels of comorbidity. We considered BMI to be a measure of nutritional status, because it has been shown that malnutrition is associated with a worse functional outcome and higher mortality in elderly persons (17,18). BMI was categorized according to the cutoff points proposed by the World Health Organization (19): <18.5 kg/m^2 (underweight), 18.5–24.9 kg/m^2 (normal range), 25–29.9 kg/m^2 (mildly overweight), and ≥30 kg/m^2 (moderately to severely overweight).

Analytic Approach

Age was categorized into three groups: 65–74, 75–84, and >84 years. The type of ward (geriatric vs internal medicine) was considered to investigate whether it had any relevant influence on FD. Finally, the number of drugs was categorized into tertiles.

We compared patients with and without CIA by using contingency tables. The association between the variables of interest and FD was evaluated by using odds ratios (OR) with 95% confidence intervals (95% CI). To calculate the OR for the association between CIA and FD corrected by potential confounders and to take into account the clustering of observations within participating centers we used a generalized estimating equation (GEE). We entered into the model those variables associated with FD at the univariate analysis and gender.

To evaluate if changes in cognitive status during hospitalization influenced the risk for FD and to take into account the possibility that part of the cognitive impairment on admission was due to undiagnosed delirium, we repeated the analysis excluding patients whose HAMT score changed between admission and discharge.

We also tested the association between CD during hospital stay (defined as loss of at least 1 point in HAMT score between admission and discharge) and FD. We repeated the analysis both in the whole sample and separately in cognitively impaired and cognitively unimpaired patients, because the significance of cognitive changes might be different between the two groups.

Results

The mean age of study participants was 77.4 ± 7 years, 52.3% were women, and 21% of the sample had CIA. Compared with participants who were not cognitively impaired, those who were cognitively impaired were, on average, 4 years older (80.3 vs 76.6 years; $p < .001$) and more frequently women (62.5% vs 49.6%; $p < .001$). On average, they had lower a ADL score on admission (4.2 vs 5.4; $p < .001$), a lower educational level (4.5 vs 5.7 years; $p < .001$), and a lower BMI (24.5 vs 25; $p < .001$). Almost 70% of the sample was admitted to a geriatric ward. Patients admitted to geriatric wards were older (77.8 vs 76.2 years; $p < .0001$), had a lower admission ADL score (5.2 vs 5.5; $p < .0001$), and were more frequently cognitively impaired than those patients admitted to internal medicine wards (23.4% vs 16.6%; $p < .0001$). Variables independently associated with higher risk for FD were: age >84 years,

Table 2. Univariate Analysis of Factors Associated With Functional Decline During Hospitalization

Variable	Odds Ratio	95% Confidence Interval	*p* Value
Cognitive impairment	3.10	2.30–4.20	.001
Age, y			
65–74	1		
75–84	1.36	0.95–1.96	.09
≥85	2.28	1.52–3.42	.001
Charlson Index			
0	1		
1	1.49	0.87–2.54	.14
≥2	4.30	2.72–6.81	<.001
No. of drugs			
0–4	1		
5–7	1.07	0.69–1.66	.76
>7	2.30	1.59–3.33	<.001
Disability on admission (ADL < 6)*	2.50	1.80–3.40	.001
Dementia	2.43	1.43–4.10	.003
Heart failure	1.54	1.05–2.26	.03
Delirium	2.19	1.01–4.73	.04
Pneumonia	2.31	1.27–4.20	.01
Cancer	3.01	2.12–4.27	<.001
Body mass index			
<18.5	3.75	1.75–8.03	<.001
18.5–24.9	3.81	1.54–9.40	.02
25–29.9	2.18	1.05–4.54	.032
≥30	1		

Note: *ADL = activities of daily living.

Table 3. Multivariate Analysis of the Factors Associated With the Risk for Functional Decline in Hospitalized Elderly Patients

Variable	Odds Ratio	95% Confidence Interval	*p* Value
Cognitive impairment	2.44	1.70–3.50	<.001
Age, y			
65–74	1		
75–84	1.14	0.78–1.68	.48
≥85	1.48	0.94–2.33	.09
Gender (male)	0.84	0.60–1.16	.29
No. of drugs			
0–4	1		
5–7	0.99	0.63–1.55	.97
>7	1.85	1.24–2.77	.003
Charlson Index			
0	1		
1	1.29	0.75–2.22	.36
≥2	2.83	1.70–4.75	<.001
Disability on admission (ADL < 6)*	1.43	1.01–2.02	.04
Body mass index			
<18.5	2.65	1.06–6.62	.04
18.5–24.9	1.99	0.95–4.18	.07
25–29.9	1.43	0.66–3.14	.36
≥30	1		
Cancer	1.94	1.30–2.92	.001
Pneumonia	2.25	1.22–4.13	.009
Heart failure	1.11	0.73–1.70	.61
Delirium	1.05	0.45–2.47	.90

Note: *ADL = activities of daily living.

severe comorbidity (Charlson index ≥2), polypharmacy (taking >7 drugs), delirium, heart failure, low BMI, pneumonia, and cancer (Table 2). Several other variables not reported in Table 2 (including gender, living alone, education, type of ward, smoking status, depression, diabetes, myocardial infarction, stroke, chronic obstructive pulmonary disease, and use of antipsychotic, antidepressant, or anxiolytic drugs) were not associated with FD. Length of stay was higher in patients with FD compared with those patients who did not undergo FD (21 and 15 days, respectively; $p < .001$).

Multivariate logistic regression analysis is shown in Table 3. Variables independently associated with the risk for FD were: CIA (OR 2.44; 95% CI, 1.70–3.50; $p < .001$); polypharmacy (OR 1.85; 95% CI, 1.24–2.77; $p = .003$); severe comorbidity (OR 2.83; 95% CI, 1.70–4.75; $p < .001$); cancer (OR 1.94; 95% CI, 1.30–2.92; $p = .001$), pneumonia (OR 2.25; 95% CI, 1.22–4.13; $p = .009$), ADL disability on admission (OR 1.43; 95% CI, 1.01–2.02; $p = .04$), and BMI <18.5 (OR 2.65; 95% CI, 1.06–6.62; $p = .04$. When we repeated the analysis excluding patients whose HAMT score changed during admission, we obtained similar results for CIA (OR 3.07; 95% CI, 1.85–5.11; $p < .001$).

CD occurred in 333 patients (3.7%) and was strongly associated with the risk for FD (OR 15.96; 95% CI, 10.80–23.58; $p < .001$). This association was present both in cognitively impaired (OR 11.48; 95% CI, 6.37–20.67; $p < .001$) and in cognitively unimpaired patients (OR 19.45; 95% CI, 12.20–31.00; $p < .001$).

Discussion

This study showed that CIA is an important predictor of FD during hospitalization in elderly patients independent of several confounders which were important predictors of FD but did not significantly weaken the role of CIA. Moreover, CD was strongly associated with an increased risk for FD. Three factors likely contribute to the poor functional outcome of hospitalization in some older patients: aging, diseases, and hospital care, which is often inadequate for these patients (20). Older age was not an independent risk factor for FD, in agreement with other studies showing that aging is probably less important than is the clinical status in influencing prognosis (21). As expected, cancer, pneumonia, and severe comorbidity were associated with a higher risk for disability, but the effect of CIA was independent of them. In our sample, the relationship between CIA and FD was not confounded by the presence of delirium, which was not associated with FD, in contrast with results reported by others (22). Finally, a low BMI, an index of undernutrition, was strongly associated with FD, whereas a high BMI was not. These results are in agreement with a previous GIFA study showing that low BMI is a predictor of mortality in elderly persons whereas high BMI is associated with minimum risk (18).

Hospitalization has been recognized as a critical event in the life of elderly persons. Many factors related to hospitalization may contribute to the high risk of FD, including limited mobility and bedrest (23), polypharmacy and adverse drug reactions (24), and side effects of diagnostic procedures. To some extent, the risk of FD is higher in elderly patients because the hospital environment often does not comply with the special needs of this population (25), contributing to the occurrence of FD despite the fact that the cure of the acute event that caused hospitalization would be expected to improve the health status. It is conceivable that patients with CIA are less able to cope with the risks associated with hospitalization and are more prone to negative outcomes, including FD. For instance, it has been reported that older patients with dementia may have a reduced ability to adhere to medical therapies and more difficulties in reporting adverse drug effects (26), as suggested also by another study performed on the GIFA database (27): both problems can contribute to a worse outcome during hospital stay.

It is noticeable that CD during hospitalization was a strong independent predictor of FD, both in patients with and without CIA. When a cognitive test such as HAMT is administered twice within a short period of time, the test taker is likely to show an improved performance, the so-called practice effect. The practice effect has been observed in older persons (28), although its presence is still debated in cognitively impaired persons (29,30). Therefore, a decline in the HAMT score over time probably represents a true change. The decline of mental performance might be the effect of worsening health status or of the acute event, which could be also responsible for FD. Another possibility, at least in some patients, is the development of symptoms of delirium without matching the full diagnostic criteria for this condition, the so-called subsyndromal delirium. This is a common though controversial condition in hospitalized older patients that is probably underdiagnosed and is associated with longer hospitalization, increased mortality, and lower cognitive and functional levels at follow-up (31).

Our study has some limitations that should be acknowledged. We did not routinely use a screening tool for delirium, such as the Confusion Assessment Method (32). This might have produced an underestimation of the prevalence of the syndrome. Because delirium is a predictor of FD, this might imply that (in our sample) it accounts at least in part for the predictive effect of CIA on FD. However, we do not believe that this is a major bias, because physicians were instructed to use the Diagnostic and Statistical Manual-IIIR criteria for delirium throughout hospitalization. Moreover, when we repeated the analysis including only those patients whose HAMT score did not change between admission and discharge, and were therefore less likely to have experienced delirium, the results were unchanged. We did not evaluate acute illness severity, which might be an important factor associated with FD during hospitalization (33). Finally, this study was performed in Italy, where there is a public health care system and, although the Diagnosis-Related Group (DRG) system of payment was introduced in 1995, the length of stay is still longer than it is in the United States. Therefore, these results might be not generalizable to the American older hospitalized population to the same degree they are to the same population in Europe.

This study also has important strengths. It clearly demonstrated the independent effect of CIA on the risk of FD, taking into account several important confounders, including BMI and polypharmacy. Moreover, it evaluated the effect of cognitive changes on the risk of FD during hospitalization, showing that older patients with CIA who undergo further cognitive loss have the highest risk of FD.

Summary

Our data indicate that CIA as well as CD represent important risk factors for FD during hospitalization in elderly patients. Therefore, they reinforce the importance to assess cognitive status of all hospitalized older adults both on admission and at regular intervals during hospitalization. Moreover, they suggest the necessity to plan future research to investigate and identify the mechanisms responsible for this increased vulnerability to FD.

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