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The Effect of Poststroke Delirium on Short-Term Outcomes of Elderly Patients Undergoing Rehabilitation

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Abstract

Objectives: Delirium is a common poststroke complication, but its prevalence and effect in rehabilitation settings is unknown. We retrospectively assessed the prevalence of delirium in elderly patients undergoing poststroke rehabilitation and its association with short-term outcomes. **Methods:** All patients (aged $\geq$65 years) admitted to the Department of Rehabilitation between November 2007 and October 2011 after a recent stroke were screened for delirium. Delirium was diagnosed using the confusion assessment method. Multiple logistic regressions were used to evaluate the association between delirium, institutionalization, and inhospital death, while multiple linear regressions were used for the association between delirium and functional recovery, defined in 3 different ways which include (1) measuring the relative functional gain of the Barthel index (BI-RFG); (2) the change in Barthel index (BI) walking subscore from admission to discharge; and (3) the change in Tinetti score from admission to discharge. **Results:** In all, 58 (33%) patients of the total 176 patients were consecutively admitted to our department with delirium. After adjustment for potential confounders, poststroke delirium (PSD) was an independent predictor of institutionalization (odds ratio [OR] = 7.23; 95% confidence interval [CI] = 4.79 to 10.91; $P \leq .0003$) and inhospital death (OR = 4.26; 95% CI = 1.15 to 15.81; $P = .03$); PSD was not a predictor of functional recovery at discharge, neither using the BI-RFG ($P = .96$) nor using the change from admission to discharge of both the BI walking subscore ($P = .57$) and the Tinetti score ($P = .61$) as outcome measures. **Conclusions:** In elderly patients undergoing poststroke rehabilitation, delirium is an independent predictor of institutionalization and inhospital death, but it does not affect functional recovery.

Keywords

stroke, delirium, nursing home, death, functional recovery

Introduction

Delirium is a serious neuropsychiatric syndrome that is characterized by acute and fluctuating disturbance of consciousness, inattention, and deficits in arousal and cognition.[1] It is one of the most common inhospital complications[2,3] occurring in approximately 1 in 5 patients, especially in the elderly patients with high comorbidity and/or preexisting cognitive impairment.[4] Previous studies have shown that the incidence of poststroke delirium (PSD) is higher (13-48%),[5-9] compared to the 10% to 25% incidence in patients admitted to general internal medicine wards.[10] Patients with PSD have unfavorable outcomes, including higher mortality, longer hospitalizations, greater risk of dementia,[7] and greater degree of functional dependence after hospital discharge.[6,8]

Currently, a relevant proportion of patients with stroke are transferred from hospitals to the rehabilitation facilities in order to start or continue their process of functional recovery. In the United States, nearly 30% of the patients with acute stroke are usually transferred to intensive rehabilitation or skilled nursing facilities to receive rehabilitation. These data refer to a study by Freburger and colleagues, using data from the American Hospital Association Annual Survey Database on more than 1 80 00 patients admitted between 2005 and 2006.[11] In Italy, according to a recent report of the Ministry of Health, more

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than half of all the patients admitted to stroke units are usually transferred to rehabilitation facilities and about one-third are transferred directly to home.[12]

Therefore, the potential impact of PSD on the final outcome of rehabilitation should be regarded with particular attention by physicians working in postacute settings, for its possible implication on clinical outcomes and functional recovery. Nonetheless, studies of PSD in rehabilitation settings are lacking.

The aims of this study were to describe the prevalence of PSD in elderly patients admitted to a rehabilitation center and to evaluate its association with adverse outcomes, including functional recovery, institutionalization, and mortality.

Methods

Study Design and Population

This was a single-center retrospective cohort study conducted at the Department of Rehabilitation and Aged Care (DRAC) of the Ancelle della Carità Hospital (Cremona, Italy); an 80-bedward devoted to the inhospital rehabilitation of postacute and chronic disabilities of elderly patients. The general characteristics of our DRAC have been already described in detail.[13] Briefly, the most frequent reasons for DRAC admission are postsurgical interventions (hip fracture surgical repair; hip or knee arthroplasty; abdominal, cardiac, or thoracic surgery), stroke (recent or chronic), peripheral vascular diseases, subacute and chronic heart failure, subacute and chronic obstructive pulmonary diseases, Parkinson diseases and parkinsonisms, or gait and balance disorders owing to a single or mixed etiology, including hypokinetic syndrome.

The study population was selected among all patients aged 65 years and older with recent (<1 month) ischemic or hemorrhagic stroke, first and consecutively admitted from the stroke unit and/or the neurological department of the local community hospital to our DRAC in the period between November 2007 and October 2011. The stroke unit and/or the neurological department of the local hospital usually transfer patients with stroke toward 3 different rehabilitative centers on the basis of bed availability (ie, the first bed available in the rehabilitation setting). Patients are selected for rehabilitation by the neurologists according to possible functional and/or cognitive improvement.

Exclusion criteria of this study included patients urgently transferred to the acute hospital during DRAC stay because of unavailability of information regarding the next destination and outcome at the time of the acute hospital discharge.

Informed consent was waived because of the retrospective nature of the study. The study was approved by the institutional review board of the Ethics Committee of Gerontological Sciences, Geriatric Research Group, Italy.

Rehabilitation Training

All patients attended a 1-hour session of physical exercises twice daily Monday through Friday and a 1-hour session on Saturday in accordance with their clinical condition. The physical exercise program was managed by a physical therapist, with the goals of enhancing flexibility, range of motion in joints, strength of arms and legs, coordination, static and dynamic balance, and, especially, transfers, postural, and gait training. A neurocognitive and/or occupational rehabilitation program was prescribed when required by the team members.

Multidimensional Assessment

All patients were evaluated with a standardized multidimensional assessment including age, gender, malnutrition (defined with Mini Nutritional Assessment Score <17),[14] laboratory measures (albumin, C-reactive protein serum levels), functional status measured with the Lawton and Brody's instrumental activities of daily living,[15] the Barthel index (BI),[16] the BI walking subscore, and the Tinetti score.[17] The BI is a tool that is frequently used in rehabilitation to evaluate functional recovery in patients with stroke.[18] It was assessed through surrogate interview before admission, on rehabilitation admission, and at rehabilitation discharge. The BI before admission was estimated based on proxy reports and referred to the prior acute event. The Tinetti scale is a performance-based instrument whose score ranges from 0 (maximum impairment) to 28 (best performance), addressing gait and balance. Cognitive status and presence of depressive symptoms were assessed with the Mini-Mental State Examination (MMSE)[19] and the 15-items Geriatric Depression Scale.[20] The latter was administered only to patients with a MMSE greater than or equal to 15 of 30. We also collected the occurrence of adverse clinical events (ACEs) during DRAC stay, including cardiovascular and respiratory events, urinary and nonurinary tract infections, and falls.

Covariates and Outcomes

Delirium, the main variable of interest, was screened on DRAC admission and at discharge using the confusion assessment method (CAM)[21] and diagnosed by expert senior geriatricians according to the *Diagnostic and Statistic Manual Disorder, fourth edition, text revision* (DSM-IV-TR) definition.

The adverse outcomes related to delirium were functional recovery at rehabilitation discharge, institutionalization (ie, discharge to nursing home [NH]), and mortality during DRAC stay. Functional recovery was assessed using 3 different measures including the relative functional gain of the BI (BI-RFG)[3] and the change from admission to discharge of both BI walking subscore and Tinetti score. The BI-RFG was computed as ([BI discharge−BI admission]/[BI before admission−BI admission]) × 100, where BI before admission−BI admission denotes functional loss before admission and BI discharge−BI admission denotes gain following rehabilitation The changes from admission to discharge of both BI walking subscore and Tinetti score were collected as measures of recovery in the gait and balance performance.

Statistical Analysis

The *t* test for pair comparison of continuous variables and the chi-square test of dichotomous variables were used to examine

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the differences between patients with and without delirium. The association between delirium and negative outcomes was tested using a multivariate logistic regression model for institutionalization and mortality and 3 multivariate linear regression models for functional recovery (BI-RFG and the change from admission to discharge of both BI walking subscore and Tinetti score). In both cases, the models were adjusted for specific covariates, selected within those significantly associated with delirium according to bivariate analyses ($P < .05$). All analyses were performed using version 11.0 of the SPSS package (SPSS Inc, Chicago, Illinois).

Results

A total of 185 patients were admitted to our DRAC for poststroke rehabilitation. Of these, 9 were readmitted to the local hospital because of clinical instability requiring an intensive approach and were, therefore, excluded from further analyses. Nonetheless, none of these patients had delirium on admission. The remaining patients (n = 176) were included in this study.

Patients were on average old (mean age 81.7 $\pm$ standard deviation 6.4) and predominantly females. Almost 1 of the 3 patients transferred, with a diagnosis of acute stroke, had delirium on admission (Table 1).

Comparing patients with and without delirium revealed no significant difference in age, social status, basal and instrumental ADL before stroke, type of stroke, and time from stroke to DRAC admission. The serum albumin levels as well as the percentage of patients who received at least 4 drugs on admission were similar in both the groups. Patients with delirium had significantly higher C-reactive protein serum levels, prevalence of malnutrition, and cognitive impairment, while no difference was found for depressive symptoms. Functional impairment on admission was greater in the group with delirium. Of the patients with delirium, 79.3% had at least 1 ACE during DRAC stay. Delirious patients had significantly worse outcomes, including lower functional recovery, higher rates of discharge to NH, and death. Only 8 patients had delirium at discharge, of whom 4 were in the group with PSD on admission.

Delirium on admission was found as an independent predictor of institutionalization (odds ratio, [OR] = 7.23; 95% confidence interval, [CI] = 4.79-10.91; $P \leq .001$) and mortality (OR = 4.26; 95% CI = 1.15-15.81; $P = .0304$; Table 2). Other predictors of institutionalization were malnutrition (OR = 5.71; 95% CI = 1.62-20.09; $P = .006$), the presence of bladder catheter (OR = 4.56; 95% CI = 1.36-15.28; $P = .013$), and BI on admission (OR = 0.94; 95% CI = 0.91-0.97; $P = .001$), while other predictors of mortality were malnutrition (OR = 6.94; 95% CI = 1.85-26.0; $P = .004$) and serum levels of C-Reactive protein (OR = 1.21; 95% CI = 1.06-1.38; $P = .005$).

In all the 3 linear regression models, delirium on admission was not associated with functional recovery at discharge (Table 3). Other variables were found as predictors of functional status at discharge, with small differences according to the measure of functional status. In the first model using the BI-RFG as an outcome, independent predictors of functional recovery were the BI score on admission ($P < .001$) and the presence of bladder catheter ($P = .032$) at the time of DRAC admission. In the second model using the change from admission to discharge of BI walking subscore as an outcome, the variables predicting recovery were, again, the presence of bladder catheter ($P < .001$), malnutrition ($P < .001$), and BI walking subscore on admission ($P < .001$). Finally, in the third model using the change in Tinetti score from admission to discharge as functional outcome, the variables predicting recovery were malnutrition ($P < .001$) and Tinetti score on admission ($P < .001$).

Discussion

The study shows that PSD is frequent in patients transferred to a postacute setting for rehabilitation, and it is an independent risk factor for early death and institutionalization at discharge but not for functional recovery.

These findings extend the existing literature of studies on PSD and contribute to disseminate knowledge about this condition. In fact, this is the first study of PSD in a rehabilitation setting, since previous studies on this topic have focused only on patients in acute hospital wards and emergency department.[6,8] We provided data about the prevalence of this condition and its potential consequences on outcomes at discharge. The rate of delirium in our study is similar to studies among patients in stroke units,[6] which reported a prevalence ranging from 10% to 48%. There are some possible explanations of this finding. On one side, we can hypothesize that the prevalence rate reflects the accuracy and the timeliness of delirium assessment. Indeed, we performed a prompt assessment of delirium early on DRAC admission, using both the CAM algorithm—recognized as the most accurate bedside tool to detect delirium[22] and the DSM criteria. On the other side, admission to DRAC may be considered a stressful time frame and transition of care as a possible predisposing factor to the occurrence of delirium[23,24]—that is, patients are transferred from acute hospital to DRAC with an ambulance. An alternative, and not mutually exclusive, explanation is that PSD prevalence may reflect the high vulnerability of our population. Indeed, we included very elderly patients, with a high prevalence of malnutrition and poor prestroke functional status.

We are not able to evaluate whether the high prevalence of PSD in our study reflects the persistence of delirium after acute hospital discharge. Because previous studies suggest that PSD may last for more than 1 month[25] and the mean length of stay in stroke units or acute hospital was on average 12 days, the hypothesis that PSD was a persistent condition in our patients is not unfounded. However, the high prevalence of bladder catheter on DRAC admission in delirious patients may also support the hypothesis that delirium was the result of different practices in managing stroke of acute hospital patients. Further studies are needed to clarify this issue.

The role of delirium as a predictor of mortality and institutionalization is in line with previous studies in patients with medical conditions other than stroke.[26,27] Similarly, the

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Table 1. Clinical Characteristics of 176 Patients Newly and Consecutively Admitted After an Acute Stroke to a DRAC, According to the Presence of Delirium on Admission.[a]

	All Patients (n = 176, 100%)	No Delirium on Admission (n = 118, 67.0%)	Delirium on Admission (n = 58, 33.0%)	*P*
Age, years	81.7 ± 6.4	81.6 ± 6.6	81.9 ± 6.1	.704
Female, n (%)	118 (67.0)	86 (72.9)	32 (55.2)	.015
Living alone, n (%)	86 (48.9)	54 (45.8)	32 (55.2)	.155
Type of stroke				
Ischemic, right side, n (%)	71 (40.3)	48 (40.7)	23 (39.7)	.515
Ischemic, left side, n (%)	53 (30.1)	34 (28.8)	19 (32.8)	.356
Hemorrhagic, right side, n (%)	19 (10.8)	12 (10.2)	7 (12.1)	.442
Hemorrhagic, left side, n (%)	16 (9.1)	12 (10.2)	4 (6.9)	.342
Others, n (%)[b]	17 (9.7)	12 (10.2)	5 (8.6)	.488
Time from stroke to DRAC admission, days	12.9 ± 9.4	12.1 ± 8.6	14.7 ± 9.7	.077
Urinary catheter on admission, n (%)	56 (31.8)	29 (24.6)	27 (44.6)	.003
Albumin serum level, g/dL	3.2 ± 0.5	3.2 ± 0.5	3.1 ± 0.4	.153
C-reactive protein serum level, mg/dL	3.5 ± 4.3	3.0 ± 4.2	4.5 ± 4.3	.036
Medications >4 on fadmission, n (%)	116 (65.9)	76 (64.4)	40 (69.0)	.335
Malnutrition, n (%)[f]	42 (23.9)	21 (17.8)	21 (36.2)	.007
Instrumental activities of daily living, functions lost (0-8)	3.7 ± 3.0	4.0 ± 3.1	3.3 ± 2.9	.177
BI 1-month before admission (0-100)	86.6 ± 18.1	87.4 ± 17.7	85.2 ± 18.9	.449
BI on admission (0-100)	29.9 ± 25.4	37.7 ± 25.9	14.0 ± 15.1	<.0005
BI at discharge (0-100)	54.0 ± 36.3	63.5 ± 34.4	33.8 ± 32.2	<.0005
BI-RFG (0-100)[c]	57.3 ± 35.6	63.9 ± 34.9	41.5 ± 32.5	.001
BI walking subscore on admission (0-15)	2.9 ± 4.2	3.9 ± 4.6	0.7 ± 1.6	<.0005
BI walking subscore at discharge (0-15)	8.4 ± 6.1	9.7 ± 5.9	5.5 ± 5.7	<.0005
Tinetti score on admission (0-28)	6.7 ± 7.3	8.3 ± 7.5	3.1 ± 5.3	<.0005
Tinetti score at discharge (0-28)	15.2 ± 9.3	16.8 ± 8.9	11.0 ± 9.0	<.0005
Mini Mental State Examination (0-30)[d]	18.1 ± 7.0	20.0 ± 5.9	13.1 ± 7.4	<.0005
Geriatric Depression Scale (0-15)	5.3 ± 3.6	5.2 ± 3.6	5.9 ± 3.4	.494
Adverse clinical events (at least 1), n (%)	101 (57.4)	55 (46.6)	46 (79.3)	<.0005
Delirium at discharge, n (%)[e]	8 (5.1)	4 (3.5)	4 (9.3)	.333
Length of DRAC stay, days	40.7 ± 21.4	41.7 ± 21.2	38.6 ± 21.9	.372
Discharge to home, n (%)[d]	114 (64.8)	97 (82.2)	17 (29.3)	<.0005
Discharge to nursing home, n (%)[d]	42 (23.9)	16 (13.6)	26 (44.8)	<.0005
Death occurring during DRAC stay, n (%)	20 (11.4)	5 (4.2)	15 (25.9)	<.0005

Abbreviations: BI-RFG, relative functional gain of the Barthel index; DRAC, Department of Rehabilitation and Aged Care; BI, Barthel index.
[a]Data are intended as means ± standard deviation unless otherwise specified.
[b]Ischemic stroke in unspecified side.
[c]Functional recovery was assessed using the BI-RFG. The BI-RFG was computed as ([BI discharge−BI admission]/[BI before admission−BI admission]) × 100, where BI before admission—BI admission denotes functional loss before admission and BI discharge—BI admission denotes gain following rehabilitation.
[d]The Mini-Mental State Examination was measured on admission in patients without delirium or after delirium resolution in the others.
[e]Assessed only in survivors at discharge.
[f]Defined according to a Mini Nutritional Assessment Score <17.

observation that malnutrition is an independent predictor of both outcomes, while the presence of bladder catheter predicted institutionalization, is in accordance with the existing literature on frail elderly patients.[28-30]

Conversely, the lack of association between PSD and functional recovery deserves specific comments, since it might appear counterintuitive because of the expected role of delirium as predictor of negative outcomes. However, our findings are concordant with previous studies showing that functional recovery may be obtained if delirium is resolved during rehabilitation.[31,32] In our population, most of the poststroke survivors did not have delirium at discharge, indirectly supporting this explanation.

Thus, we could hypothesize that delirium has influenced the outcomes of our patients in 2 different ways; if it was severe or it occurred in vulnerable patients, it led to death; however, if it was not severe or it occurred in relatively healthy patients, it was not a barrier to functional recovery. This hypothesis is in agreement with findings that serum levels of C-reactive protein (a marker of clinical instability) were a predictor of death but not of functional recovery.

Our findings have practical implications. Indeed, they provide a framework on how to optimize clinical interventions and correctly allocate the use of resources in the rehabilitation of poststroke patients. For instance, the systematic assessment of PSD on admission to the rehabilitation setting may be used to recognize critical patients, to plan appropriate clinical interventions and to anticipate possible scenario to caregivers. From a research-driven perspective, these findings may be used to

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Table 2. Predictors of Institutionalization at Discharge and Inhospital Death in 176 Patients Newly and Consecutively Admitted After an Acute Stroke to a DRAC (Multiple Logistic Regression Analyses).

	Institutionalization at Discharge			Death During DRAC Stay		
	Adjusted Odds Ratio	95% Confidence Intervals	*P*	Adjusted Odds Ratio	95% Confidence Intervals	*P*
Delirium on admission	7.23	4.79-10.91	.0003	4.26	1.15-15.81	.0304
Malnutrition	5.71	1.62-20.09	.0066	6.94	1.85-26.0	.00411
Bladder catheter on admission	4.56	1.36-15.28	.0138	2.04	0.46-9.16	.3508
C-reactive protein serum levels	0.96	0.84-1.10	.5219	1.21	1.06-1.38	.0052
Barthel index score on admission	0.94	0.91-0.97	.0005	0.97	0.91-1.02	.2450

Abbreviation: DRAC, Department of Rehabilitation and Aged Care; *P*, significance.

Table 3. Predictors of Functional Recovery at Discharge in 156 Patients Admitted to a Department of Rehabilitation and Aged Care After Stroke and Surviving at Discharge (Multiple Linear Regression Analyses).[a]

	BI-RFG			Change in BI Walking Subscore From Admission to Discharge			Change in Tinetti Score From Admission to Discharge		
	B	Se B	*P*	B	Se B	*P*	B	Se B	*P*
Delirium on admission	−0.21	4.83	.96	−0.49	0.87	.57	−0.61	1.20	.61
Bladder catheter on admission	−11.12	5.18	.03	−3.35	0.87	.000	−1.76	1.27	.16
Malnutrition	−5.67	5.46	.30	−3.86	0.94	.000	−4.37	1.33	.001
C-reactive protein serum level	0.73	0.59	.22	5.83	0.10	.95	0.23	0.14	.12
BI on admission	0.94	0.10	.000	—	—	—	—	—	—
BI walking subscore	—	—	—	−0.38	0.09	.000	—	—	—
Tinetti score on admission	—	—	—	—	—	—	−0.15	.08	.05

BI-RFG, relative functional gain of the Barthel index; B, unstandardized coefficient; Se B, standard error; *P*, significance; BI, Barthel index.
[a]Functional recovery was assessed in 3 different statistical models using (1) the BI-RFG; (2) the change in BI walking subscore from admission to discharge; and (3) the change in Tinetti score from admission to discharge. The BI-RFG was computed as ([BI discharge−BI admission]/[BI before admission−BI admission]) × 100, where BI before admission—BI admission denotes functional loss before admission and BI discharge—BI admission denotes gain following rehabilitation.

design studies assessing the efficacy of poststroke interventions among patients with similar risk profiles.

There are several limitations in our study. First, this is a retrospective cohort and a single-center study therefore limiting the generalizability of our findings. Second, we did not assess the presence of delirium during admission to the stroke unit or to neurological department of the local hospital. Third, we excluded patients who were acutely transferred from the DRAC to the acute hospital from our analysis. Although this might interfere with our findings, all these patients were not delirious at the time of DRAC admission or readmission to the hospital. Finally, we did not measure the severity and the duration of delirium. Future studies are warranted to evaluate these 2 additional features of delirium on functional outcomes.

Conclusions

In conclusion, this is the first study to describe the prevalence and the effect of delirium in patients undergoing poststroke rehabilitation (ie, increased institutionalization and mortality) and to provide evidence that this clinical condition needs to be accurately detected and also managed in postacute hospital settings mainly devoted to the functional recovery of patients with stroke.

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Authors' Note

The investigators had full access to the data and were responsible for the study protocol, progress of the study, analysis, reporting of the study, and the decision to publish.

Author Contribution

All authors contributed in study conception and design, interpretation of results, and critically revised the manuscript. Turco, Bellelli, Morandi, and Gentile contributed to data acquisition. Turco, Bellelli, and Morandi drafted the manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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