Association Between Delirium Resolution and Functional Recovery Among Newly Admitted Postacute Facility Patients

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Background. Delirium is common among hospitalized elders and may persist for months. The adverse impact of delirium on independence may increasingly occur in the postacute care (PAC) setting. The purpose of this study is to examine the association between delirium resolution and functional recovery in skilled nursing facilities specializing in PAC.

Methods. Patients were screened for delirium on admission after an acute hospitalization at PAC facilities. Only patients with “Confusion Assessment Method”-defined delirium were enrolled. Delirium and activities of daily living were assessed prehospital, at PAC admission, and at four (2-week, and 1-, 3-, and 6-month) follow-up assessments to measure functional ability. Four distinct delirium resolution groups were created ranging from resolution within 2 weeks without recurrence to no resolution over 6 months. Repeated-measures analysis of covariance was used to determine if functional performance differed over time by delirium resolution status.

Results. Among the 393 PAC patients, functional recovery differed significantly (p < .0001) by delirium resolution status. Patients who resolved their delirium by 2 weeks without recurrence regained 100% of their prehospital functional level, whereas patients who never resolved their delirium retained less than 50% of their prehospital functional level. Patients with slower resolving delirium and recurrent delirium had intermediate functional outcomes.

Conclusions. Resolution of delirium among PAC patients appears to be a prerequisite for functional recovery. Delirium resolution within 2 weeks without recurrence is associated with excellent functional recovery. Effective strategies to resolve delirium promptly and prevent its recurrence in the PAC setting will likely benefit patient rehabilitation and functional recovery.

Delirium is a common, morbid, and costly condition among hospitalized patients, and is associated with adverse events that lead to loss of independence (1–6). Discharging patients quickly from acute care facilities is becoming common, despite mounting evidence suggesting that delirium may persist for months (6–9). Many of these patients are discharged to postacute care (PAC) facilities due to incomplete resolution of cognitive and functional problems that prevent their immediate return home. Consequently, much of the long-term sequelae of delirium may occur in the postacute setting rather than in the hospital.

Despite information suggesting that delirium may be prevalent in the postacute setting, only recently has delirium in this setting received its due attention. Recently, using assessments performed by interviewers specifically trained to detect delirium (10), we reported the prevalence, symptoms, and delirium severity of newly admitted postacute facility patients. However, the study did not follow those patients over time. We subsequently reported characteristics associated with delirium persistence among newly admitted postacute facility patients (7). Recently, we compared outcomes of patients with delirium, subysyndromal delirium, or no delirium admitted to postacute skilled nursing facilities (SNFs) (11).

A number of studies (2,4–6,12,13) have reported associations between delirium and poor functional recovery. However, we know of only one study (14) that examined this association in the postacute setting. That study suggested that delirium may play an important role in the functional recovery of postacute patients, but relied on assessments by nursing facility staff not specifically trained to assess delirium and used symptoms of delirium rather than a diagnosis of delirium. Furthermore, this study only included 1-week follow-up (FU). Our current study used a diagnostic algorithm derived from Diagnostic and Statistical Manual of Mental Disorders (Third Edition – Revised) criteria for delirium that has been validated against a psychiatrist’s diagnosis. Furthermore, this study included four FU assessments over a 6-month period. Therefore, the purpose of this study is to examine the association between delirium resolution and functional recovery over a 6-month FU period using data on newly admitted postacute facility patients who had delirium at admission.

Methods

Study Population

Patients and their caregivers were recruited between October 1, 2000 and December 31, 2003 into a randomized...
trial of a Delirium Abatement Program from eight active greater-Boston SNFs specializing in PAC. All patients in this study had delirium at PAC admission (baseline). Using a protocol approved by our Institutional Review Board, family caregivers, acting as proxies, provided informed consent because of the compromised cognitive status of the patients. Eligible patients in this study were ≥65 years, were admitted directly from an acute-care medical or surgical hospitalization, spoke English, did not have a serious hearing impairment, were communicative prior to acute illness, were not admitted for terminal care (life expectancy <6 months), did not have end-stage dementia, were not completely activities of daily living (ADL)-dependent prior to hospitalization, and lived within 25 miles of our research site. All interviews were conducted by trained research assistants and completed preferably within 72 hours (average time to interview = 2.5 days), but not longer than 5 days after admission. A research assistant completed a standardized mental status assessment. Six assessments were used in this study: prehospital, PAC admission, 2-week, 1-month, 3-month, and 6-month. Multiple assessors were used, but the same assessor usually performed both baseline and FU interviews for a given patient. The interrater reliability of the team of assessors was excellent (kappa = 0.95) (15).

**Functional Status Assessment**

Information on the patient’s functional status was obtained using the modified Katz ADL scale (16). The Katz scale was modified to include walking and grooming in addition to the six original activities (bathing, dressing, toileting, continence, transferring, and feeding). The family caregiver’s report of the patient’s functional ability prior to the acute illness (prehospital) that resulted in hospitalization was obtained. Functional data derived from the proxies are comparable to self-report or performance-based measures (17). The patient’s functional level at PAC admission (baseline assessment) was obtained from a nurse, and FU assessments were obtained from either the nurse (if the patient was still in the PAC) or the proxy (if the patient was discharged). ADLs were rated: 0 = total dependence, 1 = partial dependence, 2 = independence yielding total scale values ranging from 0 (complete dependence) to 16 (independence).

The main outcome was the patient’s functional score at each PAC or postdischarge assessment divided by the patient’s prehospital functional score, multiplied by 100. This metric was chosen because we considered the patient’s prehospital ADL functional ability to be the reference level to which the patient would ideally strive to return after illness. Thus, the measurement can be described as the percentage of the patient’s prehospital functional ability. For example, at a specific assessment time, a value of 80 would imply that the patient is currently functioning at 80% of prehospital functional level. Only patients who had a prehospital functional assessment were included in this study (<5% had missing values).

**Delirium Assessment**

The Confusion Assessment Method (CAM) is a diagnostic algorithm derived from DSM-III-R criteria for delirium. The CAM allows trained research assistants to perform ratings of delirium presence that agree with a psychiatrist’s diagnosis with greater than 95% sensitivity and specificity, even in populations with a high prevalence of dementia (18). The CAM diagnostic algorithm involves four criteria: (1) an acute change in mental status with a fluctuating course, (2) inattention, (3) disorganized thinking, and (4) an altered level of consciousness (18). Delirium was considered present if CAM criteria 1 and 2 were present, and either criterion 3 or 4 was present.

Delirium resolution status was analyzed using a categorical variable with four values representing four distinct delirium resolution groups. Group 1 included patients who resolved their delirium by 2 weeks and whose delirium never recurred during FU. Group 2 included patients who resolved their delirium after 2 weeks and whose delirium never recurred during FU. Group 3 included patients who resolved their delirium at any time point, but whose delirium recurred during FU. Group 4 included patients who never resolved their delirium during FU.

**Covariates**

Several patient characteristics were controlled for in the multivariable analysis. Age, gender, race (white vs nonwhite), and educational level (≥high school vs < high school) were assessed at baseline as were other covariates described below. The number of delirium symptoms, delirium severity, age, and prehospital cognitive impairment are associated with delirium persistence in a PAC population (7).

The Delirium Symptom Interview (19) is a valid and reliable structured interview for diagnosing the presence of specific critical symptoms of delirium in an objective and straightforward manner, and can be administered by lay interviewers (7,10). A Delirium Symptom Interview score was calculated and the value of the score represents the number of delirium symptoms.

The Memorial Delirium Assessment Scale (20) allows trained research personnel to quantify the severity of delirium based on 10 features (reduced level of consciousness, disorientation, short-term memory impairment, impaired digit span, reduced ability to maintain and shift attention, disorganized thinking, perceptual disturbance, delusions, decreased or increased psychomotor activity, and sleep–wake cycle disturbance), each scored from 0 to 3 for a maximum total score of 30. A higher score indicates greater delirium severity.

The Blessed Dementia Rating Scale (21) was used to assess cognitive ability prior to hospitalization. This scale was designed to be completed by the patient’s primary caregiver and has been corroborated with pathological findings. Proxy rating of the patient’s cognitive ability prior to acute illness and hospitalization was obtained at baseline. Higher scores (0–28) indicate greater levels of impairment.

A brief interview has been validated to obtain the data necessary to complete the Charlson Comorbidity Score from patients or caregivers (22). This interview was administered to the proxy at study intake to assess current comorbidity, and included whether the patient had ever been given a diagnosis of Alzheimer’s disease or dementia.
We did not want the intervention effect, if present, to influence the association between delirium resolution and functional recovery. A variable indicating whether a patient was in a control or intervention facility was created and used in multivariable analysis but was not included in Table 1 because it will be described in detail elsewhere.

Statistical Analyses

Chi-square analysis was used for categorical variables, and analysis of variance (ANOVA) was used for continuous variables to compare percentages and mean values (respectively) by delirium resolution status. Group-specific chi-square analyses and post hoc tests from ANOVA analyses were used to determine specific group differences, in cases where overall group differences were statistically significant.

Repeated-measures analysis of covariance (ANCOVA) was used to determine whether mean functional (ADL) scores differed over time (time effect), by delirium resolution status (group effect), and most importantly, whether mean functional scores varied over time differently by delirium resolution status (interaction effect) while controlling for factors (see covariate section) that could potentially confound the association between delirium resolution status and functional recovery. Repeated-measures ANCOVA was performed using Proc Mixed in SAS (23), which permits average values of potentially confounding characteristics included in the repeated-measures ANCOVA. The p values for Table 1 were derived from ANOVA and chi-square analyses. Gender, race (white), comorbidity, and number of delirium symptoms did not significantly differ by delirium resolution status. High School education (p = .02) (group differences: G2–G4, G3–G4), age (p = .04) (group differences: G1–G4), prehospital cognitive ability (p = .0001) (group differences: G1–G3, G1–G4, G2–G4), dementia (p = .0004) (group differences: G1–G3, G1–G4, G2–G3), and delirium severity (p = .0001) (group differences: G1–G2, G1–G3, G1–G4) differed significantly by delirium resolution status.

Each functional assessment score differed significantly by delirium resolution status (p = .0001). Table 2 presents mean functional (ADL) scores assessed at prehospital (group differences: G1–G4, G2–G4), baseline (group differences: G1–G4, G2–G4), 2 weeks (group differences: all groups differed except G2–G3), 1 month (group differences: all groups differed except G2–G3), 3 months (group differences: G1–G3, G1–G4, G2–G4, G3–G4), and 6 months (group differences: all groups differed except G3–G4) by delirium resolution status.

Table 1. Descriptive Statistics for Postacute Care Patient Characteristics by Delirium Resolution Status

<table>
<thead>
<tr>
<th>Baseline Characteristic</th>
<th>Total Sample (N = 393)</th>
<th>Group 1 (N = 72)</th>
<th>Group 2 (N = 120)</th>
<th>Group 3 (N = 89)</th>
<th>Group 4 (N = 112)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, N (%)</td>
<td>256 (65.1)</td>
<td>43 (59.7)</td>
<td>82 (68.3)</td>
<td>63 (70.8)</td>
<td>68 (60.7)</td>
<td>.30</td>
</tr>
<tr>
<td>White, N (%)</td>
<td>356 (90.6)</td>
<td>63 (87.5)</td>
<td>106 (88.3)</td>
<td>81 (91.0)</td>
<td>106 (94.6)</td>
<td>.30</td>
</tr>
<tr>
<td>&gt;High school education, N (%)</td>
<td>88 (24.0)</td>
<td>29.4</td>
<td>20 (17.7)</td>
<td>15 (17.9)</td>
<td>33 (32.3)</td>
<td>.02</td>
</tr>
<tr>
<td>Dementia (AD or other), N (%)</td>
<td>132 (33.6)</td>
<td>15 (20.8)</td>
<td>31 (25.8)</td>
<td>43 (48.3)</td>
<td>43 (38.4)</td>
<td>.0004</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>84.0 (7.3)</td>
<td>82.4 (6.7)</td>
<td>83.3 (7.0)</td>
<td>84.0 (7.6)</td>
<td>85.4 (7.6)</td>
<td>.04</td>
</tr>
<tr>
<td>Prehospital cognitive ability (BDRS), mean (SD)</td>
<td>7.4 (4.7)</td>
<td>5.6 (3.7)</td>
<td>6.3 (3.9)</td>
<td>7.7 (4.8)</td>
<td>9.3 (5.3)</td>
<td>.0001</td>
</tr>
<tr>
<td>Charlson comorbidity score, mean (SD)</td>
<td>2.6 (2.4)</td>
<td>2.4 (2.3)</td>
<td>2.4 (2.0)</td>
<td>2.8 (2.1)</td>
<td>2.9 (3.0)</td>
<td>.29</td>
</tr>
<tr>
<td>No. of delirium severity (MDAS), mean (SD)</td>
<td>12.5 (4.1)</td>
<td>10.3 (3.7)</td>
<td>12.4 (3.8)</td>
<td>12.6 (3.7)</td>
<td>13.8 (4.5)</td>
<td>.0001</td>
</tr>
<tr>
<td>No. of delirium symptoms (DSI), mean (SD)</td>
<td>5.7 (1.4)</td>
<td>5.4 (1.3)</td>
<td>5.7 (1.5)</td>
<td>5.6 (1.4)</td>
<td>5.9 (1.5)</td>
<td>.12</td>
</tr>
</tbody>
</table>

Notes: Group 1 resolved their delirium by 2 weeks, and delirium did not recur during the follow-up (FU). Group 2 resolved their delirium after 2 weeks, and delirium did not recur during the FU. Group 3 resolved their delirium (any time), and delirium recurred during the FU. Group 4 never resolved their delirium during the FU. Intervention status was included as a covariate in the repeated-measures analysis of covariance model but was not included in this table because it will be described elsewhere.

AD = Alzheimer’s disease; BDRS = Blessed Dementia Rating Scale; MDAS = Memorial Delirium Assessment Scale; DSI = Delirium Symptom Interview; SD = standard deviation.
Table 2. Unadjusted Mean (SD) Functional (ADL) Scores and Unadjusted Mean Percentage of Prehospital Functional Ability by Assessment Times and Delirium Resolution Groups

<table>
<thead>
<tr>
<th>Assessment Time</th>
<th>Sample</th>
<th>Group 1 (N = 393)</th>
<th>Group 2 (N = 72)</th>
<th>Group 3 (N = 120)</th>
<th>Group 4 (N = 89)</th>
<th>Group 4 (N = 112)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prehospital (n = 393)</td>
<td>Mean (SD)</td>
<td>13.3 (3.3)</td>
<td>14.2 (2.8)</td>
<td>13.9 (2.6)</td>
<td>13.3 (3.0)</td>
<td>12.1 (4.0)</td>
<td>.0001</td>
</tr>
<tr>
<td>Mean percentage</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>PAC admission (n = 385)</td>
<td>Mean (SD)</td>
<td>7.5 (3.3)</td>
<td>8.6 (3.0)</td>
<td>7.7 (3.1)</td>
<td>7.5 (2.9)</td>
<td>6.6 (3.5)</td>
<td>.0007</td>
</tr>
<tr>
<td>Mean percentage</td>
<td>58</td>
<td>66</td>
<td>56</td>
<td>59</td>
<td>57</td>
<td>.19</td>
<td></td>
</tr>
<tr>
<td>2-week (n = 370)</td>
<td>Mean (SD)</td>
<td>8.0 (3.5)</td>
<td>9.7 (3.4)</td>
<td>8.2 (3.4)</td>
<td>8.1 (2.7)</td>
<td>6.7 (3.7)</td>
<td>.0001</td>
</tr>
<tr>
<td>Mean percentage</td>
<td>64</td>
<td>75</td>
<td>59</td>
<td>65</td>
<td>59</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>1-month (n = 357)</td>
<td>Mean (SD)</td>
<td>9.0 (4.3)</td>
<td>11.4 (4.1)</td>
<td>9.6 (4.3)</td>
<td>8.9 (3.5)</td>
<td>6.6 (4.2)</td>
<td>.0001</td>
</tr>
<tr>
<td>Mean percentage</td>
<td>72</td>
<td>95</td>
<td>68</td>
<td>71</td>
<td>61</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>3-month (n = 307)</td>
<td>Mean (SD)</td>
<td>9.5 (4.8)</td>
<td>12.1 (4.5)</td>
<td>10.7 (4.5)</td>
<td>9.0 (3.8)</td>
<td>6.1 (4.6)</td>
<td>.0001</td>
</tr>
<tr>
<td>Mean percentage</td>
<td>72</td>
<td>95</td>
<td>75</td>
<td>70</td>
<td>51</td>
<td>.0001</td>
<td></td>
</tr>
<tr>
<td>6-month (n = 274)</td>
<td>Mean (SD)</td>
<td>9.6 (5.0)</td>
<td>12.6 (4.1)</td>
<td>10.6 (4.6)</td>
<td>8.0 (4.4)</td>
<td>6.1 (4.7)</td>
<td>.0001</td>
</tr>
<tr>
<td>Mean percentage</td>
<td>75</td>
<td>114</td>
<td>75</td>
<td>64</td>
<td>50</td>
<td>.003</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Group 1 resolved their delirium by 2 weeks, and delirium did not recur during the follow-up (FU). Group 2 resolved their delirium after 2 weeks, and delirium did not recur during the FU. Group 3 resolved their delirium (any time), and delirium recurred during the FU. Group 4 never resolved their delirium during the FU. Mean percent values were adjusted for intervention status and characteristics included in Table 1 via the repeated-measures analysis of covariance.

DISCUSSION

In this prospective longitudinal study of 393 PAC patients, those who resolved their delirium by 2 weeks without recurrence during the 6-month FU regained 100% of their prehospital functional level. Patients who never resolved their delirium during the 6-month FU functionally declined over time, retaining no more than 50% of their prehospital functional level. Patients who resolved their delirium more slowly and those with recurrent delirium had intermediate functional outcomes. This relationship existed independent of gender, race, education, age, mental status before hospitalization, dementia, comorbidity, delirium severity at PAC admission, number of delirium symptoms, and intervention status.

Note that the four groups were not significantly different in terms of baseline prehospital functional scores (p = .19), and that delirium resolution occurred in groups 1, 2, and 3, but group 1 patients clearly had the best functional recovery. The key points culled from these analyses are that early resolution of delirium (by 2 weeks) and the absence of recurrence appear to play a major role in functional recovery. Finally, note that functional recovery for Group 1 patients was greater than 100% of their premorbid functional level, suggesting very successful rehabilitation and/or some measurement error.

Findings from our study are consistent with previous publications. O’Keeffe and Lavan (4) studied patients admitted to an acute hospital and reported that patients with delirium were more likely to have functional disability. Francis and Kapoor (5) demonstrated that delirium status could identify older patients at risk for loss of functional independence. Murray and colleagues (2) found that persons who developed delirium in the hospital experienced a significant loss of physical function subsequent to their delirious episode. Inouye and colleagues (12) reported that delirium at hospital admission was significantly associated with functional decline, independent of age, gender, dementia, APACHE II score, ADL score, and Instrumental ADL score. None of these studies examined ADL outcomes among those whose delirium persisted versus those whose delirium did not persist.

We previously reported that delirium was independently associated with poor functional recovery 1 month after hip fracture and that patients who had persistent delirium at
1 month had worse functional recovery than those whose delirium had resolved (6). We also reported that PAC patients with at least the same number of delirium symptoms at the FU assessment had substantially worse functional recovery than patients with fewer or resolved delirium symptoms who had a functional trajectory similar to those without any delirium (14). McCusker and colleagues (13) also reported that patients with persistent delirium had the worst outcomes, including functional ability, compared to patients with transient delirium.

This study has advantages and limitations worthy of discussion. Trained research personnel, using an established and validated diagnostic algorithm (CAM), performed assessments. Although the death and withdrawal rates were substantial (relative to the age and morbidity of this population), they did not have a substantial influence on the analyses. Our data were collected from a single metropolitan region and may not generalize to rural locations. Results of our study involving PAC SNF patients may not generalize to individuals receiving PAC in a residence or rehabilitation hospital. Finally, although our assessments were performed with 2.5 days of PAC admission, we cannot be sure if some of the patients developed delirium after admission to the PAC facility.

Resolution of delirium among SNF PAC patients, particularly within 2 weeks, appears to be a prerequisite for functional recovery. Our results highlight the importance of early recognition and treatment of delirium among new admissions to PAC as well as good management that may prevent the recurrence of delirium.

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