Delirium on Hospital Admission in Aged Hip Fracture Patients: Prediction of Mortality and 2-Year Functional Outcomes

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Background. Hip fracture patients are at increased risk of confusion or delirium due to the trauma associated with the injury and the rapid progression to hospitalization and surgery, in addition to the pain and loss of function experienced. Hip fracture patients who develop delirium may require longer hospital stays, are more often discharged to long-term care, and have a generally poor prognosis for returning home or regaining function in activities of daily living (ADL).

Methods. The present study examines the impact of delirium present on hospital admission in a sample of 682 non-demented, aged hip fracture patients residing in the community at the time of their fracture. In-hospital assessments designed to assess both prefracture and postfracture functioning, as well as follow-up interviews at 2, 6, 12, 18, and 24 months postfracture, were obtained from participants.

Results. Analyses indicate that baseline or admission delirium is an important prognostic predictor of poor long-term outcomes in persons without known cognitive impairment, after controlling for age, gender, race, comorbidity, and functional status. Delirium at admission (i.e., prior to surgery) was associated with poorer functioning in physical, cognitive, and affective domains at 6 months postfracture and slower rates of recovery. Impairment and delays in recovery may be further exacerbated by increased depressive symptoms in confused patients over time. Delirium on hospital admission was not a significant predictor of mortality after adjustment for confounding factors.

Conclusions. The present findings further emphasize the significance of immediate detection and treatment of delirium in hip fracture patients to ameliorate the short and long-term effects of acute confusion on functional outcomes.

D ELIRIUM is an acute confusional state that is common and serious in hospitalized older adults, with an estimated 10%–56% of elderly patients experiencing this syndrome during their hospital stay (1–11). Prospective studies have identified several predisposing factors for the development of delirium among hospitalized older adults including older age, dementia, depression, severe illness, fracture on admission, greater impairment in physical function, and institutionalization prior to admission (1,5,8,10,12,13). In older adults, delirium may be the only indicator of an urgent medical condition or underlying disease (14,15). Hip fracture patients are at increased risk of confusion or delirium because of the trauma associated with the injury and the rapid progression to hospitalization and surgery, in addition to the pain and loss of function experienced (10,11). Prevalence of acute confusion may be as high as 61% among hip fracture patients during their hospital stay (16), with approximately 20%–33% of patients exhibiting delirium at the time of hospital admission (12,14).

Episodes of delirium among hospitalized older adults are associated with increased lengths of hospitalization and a greater likelihood of institutionalization either immediately or within a few months of hospital discharge (1,5,7,13,14,16–

20), and older adults who develop delirium are more likely to exhibit greater dependence in activities of daily living (ADL) up to 2 years later (7,19,21–23). Delirium may also be associated with cognitive decline, with some studies indicating that delirium may be a marker for cognitive impairment (21,24).

The connection between delirium and mortality is less clear, however, with some studies demonstrating an association between hospital confusion and mortality (12,13,18), and others indicating that delirium is not a significant predictor of mortality after adjustment for age, comorbid disease, functional status, and dementia (1,5,7,19,21). These latter results suggest that the relationship of delirium to mortality may be due to significant underlying medical problems that are producing symptoms of confusion (25).

To date, many studies of delirium have failed to distinguish between delirium present at admission (i.e., prior to surgical or other medical intervention) and new onset delirium developed during the hospital stay, often including both types of patients in the same analysis (10). Among hospitalized elderly persons, delirium is present in approximately 10%–24% of cases at the time of admission, and another 3%–35% develop acute confusion during their hospital stay (1,4,5,7,

8,10,12,17,19,26,27). In one of the few studies focusing solely on those confused at admission, Inouye and colleagues (19) examined functional outcomes at discharge and 3 months later for hospitalized adults aged 75 years and older. Inouye's study controlled for relevant confounding variables, including age, gender, dementia, illness severity, and baseline functional status, and indicated that delirium at admission was a significant predictor of ADL decline (i.e., mean ADL decline of 1.9 vs 0.5), and confused participants were three times more likely to have a new nursing home placement 3 months after discharge. Identifying the timing and onset of delirium is crucial, as the syndrome may have a different etiology and a unique effect on subsequent outcomes depending upon whether the disorder is present at admission or is related to the hospital experience (27). Admission delirium may be a different syndrome than that seen postoperatively.

The objective of the present study was to examine the short- and long-term impact of delirium present on hospital admission in a sample of nondemented, aged hip fracture patients residing in the community at the time of their fracture. This research expands previous work by isolating hip fracture patients who were confused at the time of hospital admission, but who had no known history of cognitive dysfunction. Patients were followed up for 2 years to assess the long-term impact of delirium at admission on physical and cognitive functioning and mortality.

METHODS

Participants

A sample of 804 hip fracture patients aged 65 years or older was recruited in 1990–1991 from eight Baltimore hospitals that treated approximately two thirds of all hip fracture patients aged 65 and older admitted to all area hospitals. All participants were community-dwelling at the time of the hip fracture. Those patients who presented with pathological fractures or resided in a nursing home, hospital, or extended care facility at the time of fracture were excluded from the study.

Eligible patients and designated proxy respondents were interviewed in the hospital between 5 and 10 days postfracture by trained research nurse interviewers. Of the 804 patients identified at the time of their hospitalization, 674 (83.8%) agreed to participate in a prospective study, and baseline hospital interviews were conducted. In-hospital assessments designed to assess both prefracture and postfracture functioning, as well as follow-up interviews at the subjects' residence at 2, 6, 12, 18, and 24 months postfracture, were obtained for participants. For those older adults who were cognitively impaired, physically ill, or unwilling to participate, proxy data were obtained at follow-up. Proxies were family members or friends who knew the patient well and could report on their health. Good concordance rates for patient and proxy reports of functional status on study measures have been reported elsewhere (28).

Approximately 15% of the sample ($n = 122$) were identified as cognitively impaired prefracture based on a medical chart notation of preexisting dementia, organic brain syndrome, or Alzheimer's disease, and were excluded from this analysis. Longitudinal data were available for 443 subjects at 2 months, 408 at 6 months, 381 at 12 months, 320 at 18 months, and 306 at 24 months after hospitalization.

Measures

Delirium or acute confusion.—Delirium or acute confusion at admission was identified through a review of medical chart notes and/or proxy interview using a modified version of the Confusion Assessment Method (CAM) (29), which is based on *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition* diagnostic criteria for delirium (30). Medical chart notes containing information regarding symptoms of disorientation, confusion, or acute delirium on admission to the hospital were identified, and patients were coded as confused/delirious at admission. Using the modified CAM, proxies were asked to evaluate the presence or absence of several aspects of the patient's behavior, including inattention, disorganized thinking, disorientation, memory impairment, altered level of consciousness, perceptual disturbances, psychomotor agitation, and altered sleep-wake cycle. Responses were scored according to the algorithm proposed by Inouye and coworkers (29), which requires the presence of four features for a diagnosis of delirium: (i) acute onset and fluctuating course, (ii) inattention, (iii) disorganized thinking, and (iv) altered level of consciousness. The presence or absence of delirium or acute confusion on admission was noted using the medical chart notes and/or the CAM proxy report.

Demographic characteristics and admitting health status.—Medical records provided demographic variables (i.e., age, race, gender, and education) and medical information on comorbidity. A modified Charlson comorbidity index (31) was created by summing points awarded for disease conditions according to the following scheme: 1 point for myocardial infarction, congestive heart failure, deep venous thrombosis (DVT), peripheral vascular disease, dementia, chronic obstructive pulmonary disease (COPD), arthritis, ulcers or diabetes; 2 points for cancer or stroke; and 3 points for cirrhosis. The possible score range was 0 to 15, with higher scores indicating poorer health status. Admitting lab slips were examined and results recorded for several lab values, including white blood cell count, hemoglobin, hematocrit, lymphocytes, serum potassium, serum sodium, blood urea nitrogen (BUN), blood creatinine, blood glucose, serum calcium, albumin, and arterial carbon dioxide. Medical stability was determined by categorizing abnormal values where appropriate, using accepted cut points (i.e., normal, high, low) (32,33) on each blood, plasma, or serum value.

Functional independence.—Lower extremity physical activities of daily living (L-PADL) were assessed using an instrument similar in structure to the Functional Status Index (34). Data were collected on prefracture status during the in-hospital assessment and postfracture status at each follow-up. Participants were asked about eleven activities: walking 10 feet or across a room; walking 1 block; climbing five stairs; getting into a car; getting in and out of bed; ris-

ing from an armless chair; putting on pants; putting socks and shoes on both feet; getting in and out of a bath or shower; taking a bath, shower, or sponge bath; and getting on and off the toilet. An impairment index was created by summing the total number of activities in which the person reported the need for human or equipment assistance or did not perform. The scale ranged from 0 to 11, with higher scores representing greater levels of impairment.

A second PADL summary scale, incorporating functions used by Katz and coworkers (22), was also created. This scale included self-reported impairment in activities comprising seven domains of lower and upper extremity physical functioning as follows: ambulation (i.e., walking 10 feet); transfer (i.e., getting in and out of bed); toileting (i.e., getting on and off the toilet); dressing (i.e., putting socks and shoes on both feet, putting on a shirt, buttoning a shirt, putting on pants); grooming; bathing (i.e., taking a shower, bath, or sponge bath); and eating. An impairment index was created by summing the total number of activities in which the person was dependent, ranging from 0 to 10, with higher scores representing greater levels of impairment.

Seven instrumental activities of daily living (IADL) were assessed using a modified version of the Older Americans Resources and Services Instrument (35). Participants were asked to report on actual performance in IADL domains during the preceding 2 weeks, rather than on perceptions of ability. The seven activities included using the telephone, getting to places out of walking distance, shopping for groceries or clothes, preparing meals, doing housework, managing finances, and taking medications. A summary score of IADL functioning was created by adding the number of activities in which the person was dependent (i.e., required human assistance or did not perform). The scale ranged from 0 to 7, with higher scores indicating greater disability.

Cognitive status.—Cognitive functioning was assessed postsurgery and at each follow-up with the Mini-Mental State Examination (MMSE) (36). This measure assesses orientation, registration, recall, attention, calculation, and language. Scores range from 0 to 30, with higher scores representing better cognitive status. Previously established cut points are often used to stage the severity of cognitive impairment (36), with scores from 24 to 30 indicating normal functioning, scores from 17 to 23 indicating mild to moderate cognitive impairment, and scores below 17 suggestive of severe impairment in cognitive status.

Affective functioning.—Depressed affect was measured after surgery and at each follow-up using the Center for Epidemiologic Studies–Depression Scale (CES-D) (37), a 20-item scale assessing feelings and behaviors indicative of depressive sympomatology. Participants were asked how often within the past week they experienced a specific behavior or feeling (rarely, sometimes, occasionally, most of the time). This scale ranges from 0 to 60, with higher scores indicating greater depressive symptoms. Participants with scores greater than 16 were considered to have depressive symptomatology.

Mortality.—Mortality information was inferred from patient or proxy contact. If patients could not be located and a proxy report was unavailable, a search of the Vital Records in the state of Maryland was conducted to determine if patients had died and the date of death. Mortality status was obtained for 675 of the 682 participants (approximately 99% of the sample).

Statistical Analysis

Longitudinal analyses were used to examine the impact of delirium at hospital admission on functional outcomes. Separate mixed models for repeated measures were examined for lower extremity ADL, walking 10 feet, IADL, depressive symptoms (i.e., CES-D), and cognitive status (i.e., MMSE). Walking 10 feet was also analyzed separately from the lower extremity ADL score. An unstructured covariance matrix was specified and found to be a good fit for each of the models. Walking 10 feet was analyzed similarly using a generalized estimating equation (GEE) (38) with binary measures to determine relative risk by delirium status. An unstructured covariance matrix was specified. Unadjusted effects of delirium on functional outcomes were examined, as well as effects adjusted for prefracture ADL impairment, prefracture status in the dependent variable, comorbidity, race, age, and gender. Main effects of time and delirium status were examined, as well as time by delirium status interactions.

Survival analysis was used to examine the relative risk of mortality over 2 years for participants experiencing delirium at hospital admission. Cox proportional hazard models were used to determine the hazard ratios associated with each factor considered. The Epidemiological Graphics, Estimation, and Testing package, or EGRET, version 1.02.10 (Cytel Software Corporation, Cambridge, MA) was used for fitting the Cox models to determine the validity of the proportional hazard assumption. Survival time was operationalized as the number of days lived since admission to the hospital. First, a model including only delirium status as a predictor of mortality was considered. Next, covariates were added to examine the relative risk of mortality by delirium status adjusted for prefracture ADL impairment, comorbidity, age, gender, and race.

RESULTS

Baseline characteristics for the study sample are presented in Table 1. Approximately 13.5% of patients were identified as confused or delirious at the time of hospital admission. Participants exhibiting confusion at admission to the hospital were significantly older, had a greater number of functional impairments, and had significantly greater numbers of illnesses. With regard to specific preexisting conditions, participants with delirium had a history of congestive heart failure, stroke, or transient ischemic attack at admission. However, a smaller proportion of participants with delirium had cancer. There were no significant differences between the two groups in the proportions with arthritis, cirrhosis, COPD, DVT, diabetes, osteoporosis, Parkinson's, peripheral vascular disease, and ulcers (see Table 1). Delirium status did not differ by gender or racial group.

Table 1. Comparison of Prefracture Patient Characteristics by Delirium Group

	Delirium (n = 92)	No Delirium (n = 590)	p Value
Age, mean (±SD)	83 (±7.1)	80 (±7.4)	<.004
Women, %	78	79	.816
White, %	93	94	.930
Comorbidities, mean (±SD)	2.3 (±1.6)	1.6 (±1.5)	<.001
History of disease conditions			
Arthritis, %	26	29	.621
Cancer, %	5	17	<.001
Cirrhosis, %	4	4	.961
Congestive heart failure, %	23	11	<.003
COPD, %	13	19	.242
Deep venous thrombosis, %	0	1	.376
Diabetes, %	12	11	.860
Osteoporosis, %	18	12	.088
Parkinson's Disease, %	7	3	.120
Peripheral vascular disease, %	7	6	.811
Stroke, %	21	8	<.001
Transient ischemic attack, %	9	3	<.012
Ulcers, %	9	7	.505
ADL impairments, mean (±SD)			
Lower extremity	4.4 (±3.6)	2.8 (±3.1)	<.001
Modified Katz	1.7 (±1.9)	0.9 (±1.5)	<.001
IADL impairments, mean (±SD)	3.8 (+2.3)	2.4 (+2.2)	<.001

Notes: Significance tests based on χ^2 or t values. COPD = chronic obstructive pulmonary disease; ADL = activities of daily living; IADL = instrumental activities of daily living.

In addition to the comorbidities shown in Table 1, medical lab values were examined. Participants identified as confused or delirious at admission were significantly more likely to have abnormally high values for white blood cells ($p < .05$; 9% vs 4%). The remaining blood, plasma, and serum values yielded no statistically significant differences between groups.

Longitudinal mixed models were used to compare functioning at 2, 6, 12, 18, and 24 months for participants exhibiting delirium at admission versus those identified as not confused. Even after adjustment for relevant covariates, significant main effects for time and delirium status were found for each outcome ($p < .05$). In addition, significant interactions with delirium were found for lower extremity ADL, walking 10 feet, and depressive symptoms, respectively ($p < .05$). Table 2 provides adjusted means and standard errors over time for each of the functional outcome variables. As can be seen in Table 2, although both groups exhibited some recovery of lower extremity ADL and IADL functioning over time, participants identified as confused at admission did not achieve the same level of recovery after 24 months. On average, confused participants were impaired in approximately one ADL and one IADL activity beyond that of nonconfused participants. A significant time by delirium status interaction was observed for lower extremity ADL. As shown in Figure 1a, participants in the no-delirium group had a steeper rate of recovery in ADL between 2 and 6 months postfracture than those confused at admission. In this time period, a 24% decrease in ADL disability was found for participants with no delirium, whereas a 12% decrease in disability characterized participants delirious at admission.

A similar pattern of recovery was found for mobility. Participants in the delirium group were less impaired in mobility at the 2-month follow-up, with 88% vs 95% unable to walk 10 feet independently. Both groups regained some function by the 6-month interview. At 12 months, however, a greater proportion of the no-delirium group had regained mobility (i.e., 51% independent vs 34% independent), and this pattern continued up to 24 months postfracture. Neither group made significant gains in mobility recovery beyond 1 year postfracture. A significant time by delirium interaction was observed for the ability to walk 10 feet. Figure 1b compares the functional trajectories for both groups.

Participants exhibiting delirium at admission had higher levels of depressive symptoms at 2 months postfracture and

Table 2. Adjusted Means[†] and Standard Errors Over Time for ADL, IADL, Depression, Cognitive Status, and Mobility by Delirium Group

	Time (months)				
	2	6	12	18	24
Lower extremity ADL[‡]					
No delirium	8.7 (0.23)	6.6 (0.23)	6.2 (0.24)	6.3 (0.24)	6.4 (0.24)
Delirium	8.2 (0.36)	7.2 (0.40)	7.2 (0.41)	7.5 (0.41)	7.5 (0.42)
IADL impairment[‡]					
No delirium	4.6 (0.19)	3.7 (0.19)	3.6 (0.19)	3.6 (0.20)	3.6 (0.20)
Delirium	5.1 (0.30)	4.6 (0.34)	4.5 (0.32)	4.5 (0.34)	4.5 (0.34)
Depressive symptoms[‡]					
No delirium	9.9 (1.01)	9.2 (1.00)	9.0 (0.99)	9.6 (1.01)	10.2 (1.04)
Delirium	13.1 (1.75)	14.5 (1.59)	11.8 (1.62)	16.0 (1.68)	15.7 (1.87)
Cognitive status[§]					
No delirium	24.1 (0.42)	24.3 (0.42)	24.0 (0.42)	23.9 (0.43)	23.5 (0.44)
Delirium	20.9 (0.67)	21.1 (0.65)	20.9 (0.68)	20.5 (0.72)	19.8 (0.78)
Walking 10 feet[‖]					
No delirium	0.95 (0.01)	0.62 (0.02)	0.49 (0.03)	0.48 (0.02)	0.48 (0.03)
Delirium	0.88 (0.03)	0.69 (0.05)	0.66 (0.05)	0.66 (0.06)	0.61 (0.06)

Notes: ADL = activities of daily living; IADL = instrumental activities of daily living.

[†]Analyses adjusted for age, gender, race, comorbid conditions, prefracture ADL, and prefracture status on the outcome.

[‡]Higher scores indicate poorer functioning.

[§]Higher scores indicate better functioning.

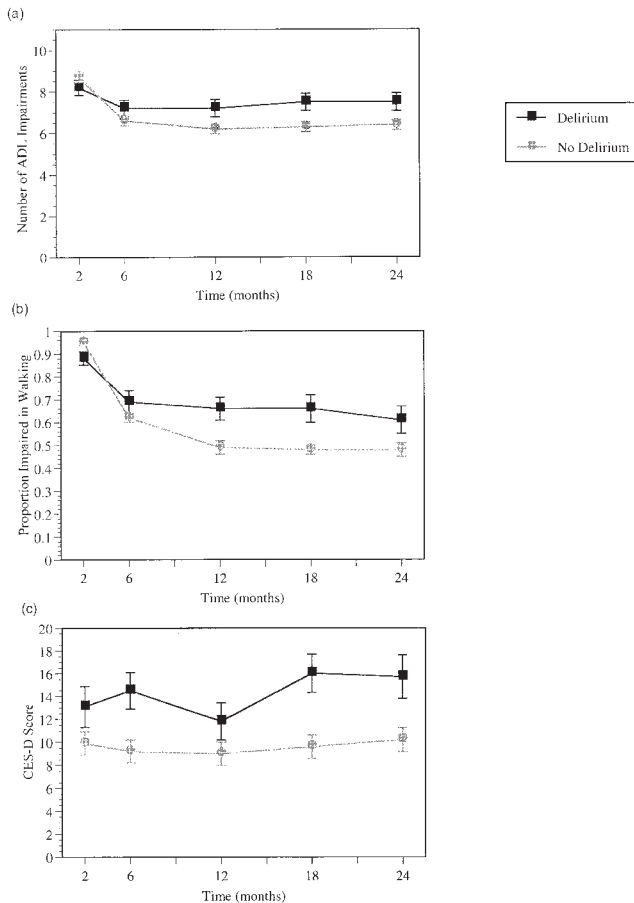[‖]Represents percentage of participants unable to walk 10 feet independently.

Figure 1. Time by delirium status interactions: activities of daily living (ADL) functioning, walking 10 feet, and depressive symptoms. CES-D = Center for Epidemiologic Studies–Depression Scale.

continued to be significantly more depressed after 2 years, even after adjustment for comorbid conditions, age, gender, race, and prefracture functional status. The postsurgical hospital evaluation revealed significant differences in depressive symptoms by delirium group. Unadjusted mean CES-D score for the delirium group was 20.5 (SD = 11.5) versus 16.4 (SD = 10.5) in those not confused at admission ($p < .05$). In fact, as shown in Figure 1c, a significant time by delirium interaction suggests that depressive symptoms increased in this group over time. In contrast, the no-delirium group displayed stability with regard to affective functioning.

An examination of unadjusted CES-D scores revealed that, at 1 year, 32.5% of participants in the delirium group, compared with 22.2% of those not exhibiting delirium at admission, scored 17 or higher on the CES-D. Participants with delirium were approximately 1.5 times more likely to exhibit depressive symptoms at the 24-month follow-up. By 2 years, the percentage of depressed individuals had increased to 48.1% in the delirium group, although the percentage remained nearly unchanged in the no-delirium group at 25.6%.

Significant differences for delirium status were also found for cognitive functioning, as assessed by the MMSE.

At the postsurgical hospital assessment, mean MMSE scores were significantly different by delirium group. On average, confused patients scored 26.2 (SD = 6.9) on the MMSE, and those not confused at admission scored 28.8 (SD = 3.5; $p < .01$). As Table 2 illustrates, participants confused at admission also scored lower on the MMSE at 2 months (adjusted means of 20.9 vs 24.1) and scores remained disparate over time.

An examination of unadjusted MMSE scores at 24 months revealed that only 53% of those with admission delirium, compared with 76% of nondelirious subjects, scored within the normal/unimpaired range on the MMSE (i.e., 24 points or greater). Those admitted with delirium were also more likely to score in the mild impairment (34% vs 17%) to severe impairment (13% vs 7%) range on the MMSE at 24 months. These results suggest that participants admitted with delirium were nearly two times more likely to be cognitively impaired at the 24-month follow-up.

Survival analysis was used to examine the probability of mortality over 24 months, given delirium at hospital admission. First, Cox regression analyses and examination of survival curves gave little indication of a delirium by time interaction ($p = .521$), indicating that the effects of delirium on mortality are reasonably constant over time. Unadjusted Cox regression analyses indicated that delirium at admission increased the relative risk of mortality by approximately 70% (relative risk 1.70, 95% confidence interval [CI] 1.15–2.50). As shown in Table 3, after adjustment for potential confounding variables (i.e., age, gender, race, comorbidity, prefracture ADL impairment), delirium was no longer a significant contributor to the risk of mortality (relative risk, 1.37, 95% CI 0.85–2.20). Approximately one half of the excess risk of mortality initially attributed to delirium was explained by the covariates included in the model (age, race, gender, comorbidity, prefracture ADL impairment).

DISCUSSION

Little is known about the effects of delirium present at hospital admission on long-term functional outcomes. This study sought to examine delirium, independent of underlying dementing illness, through exclusion of patients with known cognitive impairment. Findings from the present study indicate that baseline or admission delirium is an important prognostic indicator of poor long-term outcomes in persons without preexisting cognitive impairment, after controlling for age, gender, race, comorbidity, and functional status. Results suggest that admission delirium has a negative impact on functional outcomes to 24 months post-

Table 3. Adjusted Cox Regression Model for Hip Fracture Mortality

Factor	Hazard Ratio	95% Confidence Limits	p Value
Delirium at admission	1.37	0.85–2.20	.200
Age (years)	1.04	1.01–1.06	.012
Gender (male)	2.62	1.77–3.88	<.001
Race (white)	0.96	0.42–2.21	.928
Comorbidity	1.18	1.06–1.32	<.005
Prefracture ADL impairment	1.08	0.97–1.21	.167

Note: ADL = activities of daily living.

fracture. Participants with delirium at admission functioned significantly lower in physical, cognitive, and affective domains than those not experiencing confusion at admission. In general, delirium was associated with slowed recovery and an increased likelihood of dependency in ADLs and IADLs. It appears that admission delirium has no influence on mortality, however, after controlling for potential confounds such as age, race, gender, comorbidity, and functional status.

Approximately 13% of patients in this sample were identified as delirious at admission, a figure similar to the 10%–25% found in previous studies of hospitalized elderly patients (4,5,7,8,10,17,19,25–27), but lower than the 20%–33% found among hip fracture patients (12,14). This discrepancy is likely explained by the inclusion of dementia cases in previous studies and the exclusion of persons identified as cognitively impaired prefracture in the present study. The predisposing factors for delirium identified in previous research were also found in this study (1,5,8,10–13, 16), with older age, more comorbid conditions, and greater functional impairment placing patients at greater risk of confusion.

Delirium at admission predicted functional decline in the hip fracture patients studied. In agreement with previous studies, results indicated that by 6 months, those with delirium were impaired, on average, in one more ADL task beyond nonconfused patients (23), and that this excess impairment remained 24 months later. Francis and colleagues (1) found that confused patients were twice as likely to be dependent in ADLs 2 years later. In the present study, delirium was also associated with a poorer prognosis for regaining mobility. At 1 year postfracture, only one third of participants confused at admission were able to walk without assistance, compared with one half of those without delirium. In their study of hip fracture patients, Gustafson and colleagues (16) also found confused patients to be less likely to regain independent walking ability or return home.

With regard to affective functioning, results indicate that patients identified as confused at hospital admission were more likely to experience increased depressive symptomatology over time. Interestingly, by 24 months, the percentage of depressed individuals in the delirium group was nearly double that of those not confused at admission. In the present hip fracture cohort, confused patients exhibited higher levels of depression during their hospital stay than nonconfused patients. In fact, the mean CES-D score for delirious patients was 20.5, with 62% scoring 17 or higher, suggesting the presence of depressive symptoms in this group, even at the first measurement (i.e., postsurgical evaluation). One plausible explanation is that some patients were experiencing symptoms of depression before the hip fracture, an interpretation that is consistent with previous work identifying depression as a risk factor for delirium (13,16,39,40).

Although information regarding patient depression prior to hip fracture is not available in the present study, it is possible that existing depressive symptoms may have worsened over time for those patients delirious at hospital admission. It must also be noted, however, that delirium and depression often share common symptoms, such as mood disturbance, that may present difficulties to accurate diagnosis. For instance, in a study of 67 elderly patients referred for symptoms of depression, Farrell and Ganzini (40) found that approximately 42% of patients were actually experiencing delirium. Regardless of the etiology of affective symptoms, several studies have indicated that persistent postsurgical depression in hip fracture patients is associated with poorer functional and psychosocial recovery (41–43). The importance of recognizing and treating depression in this group, then, may be a particularly relevant goal for optimizing functional recovery.

Confused patients had lower cognitive scores postsurgery and continued to function more poorly over 24 months, with mean cognitive scores in the impaired range. After 2 years, almost one half of patients in the delirium group were considered impaired, compared with only 24% in the no-delirium group. This contrast may be particularly striking given that those participants remaining in the study for the entire 24 months are likely to be a select group. Research indicates that confused patients may perform more poorly on the MMSE over the course of the hospitalization period (1). Further, O'Keefe and Lavan (7) found that delirium produced incident memory impairment that lasted beyond 1 month in nondemented patients. Francis and Kapoor (21) found greater cognitive decline among prevalent and incident cases of delirium among community-dwelling older patients 2 years postdischarge. Further, Koponen and coworkers (24) discovered that one third of elderly patients diagnosed with delirium exhibited cognitive deterioration on the MMSE 1 year later. These researchers also found that 81% of patients with delirium displayed predisposing structural brain diseases, including Parkinson-, vascular-, and Alzheimer-type pathology. As suggested by Francis and Kapoor (21), delirium may be a marker for impaired brain reserve attributable to early dementia.

Among patients with no history of cognitive impairment, delirium at admission was a significant predictor of 24-month survival in the crude analyses, but was no longer significant after adjustment for age, gender, comorbidity, and functional status. Although some research has suggested an independent association between delirium and mortality, these studies have often failed to adjust for potential confounding variables (18) or have found a significant relationship only for in-hospital mortality (44). The present findings are in agreement with other studies indicating that delirium is not independently associated with an increased risk of death (1,5,7,16,19,21).

Strengths and Limitations

Several limitations of the present research must be acknowledged. First, the results presented may only be generalizable to nondemented, community-dwelling older adults who experience a hip fracture. This sample was limited to hip fracture patients in the Baltimore metropolitan area, and it is possible that these individuals may be different from patients in other geographic regions. Second, the operationalization of delirium or acute confusion in the present study does not represent a clinical evaluation or determination of delirium. To assess confusion, the CAM was administered

to significant others knowledgeable about the patient's condition before and after the fracture, rather than to the patient. It might be argued, however, that this method may be valid given that family members may be more alert to patient behavior at the time of admission and may have greater opportunity to monitor a patient's condition than hospital staff. Finally, the use of medical chart data to identify additional cases of confusion may not be as clinically accurate as the CAM measure, and it is possible that, for some patients, delirium was present before the hip fracture.

Conclusions and Future Directions

Consistent with the results of Inouye and colleagues (19), our study indicates that delirium is an independent predictor of poor outcomes in hospitalized elderly persons, rather than simply being a marker for illness or frailty. The causal pathway is not yet clear, however. It is possible that symptoms of confusion identified at hospital admission may precipitate a medical work-up that leads to surgical delay, prolonged immobility, and higher risk of complications. Further, patients experiencing confusion may experience excess disability if their symptoms limit the extent of rehabilitation and/or physical therapy that is provided, contributing to further ADL loss. Impairment and delays in recovery may be further exacerbated by increased depressive symptoms in confused patients over time. The persistence of delirium in elderly patients, as well as the negative impact of prolonged confusion on functional outcomes, has been well-documented in previous work (5,7,8,17), making prevention and treatment of delirium or acute confusion among older adults an important public health concern. What has not been fully documented is the relationship between delirium in older hip fracture adults on hospital admission and both functional outcomes and mortality. The findings of this study emphasize the importance of immediate detection and treatment of delirium in hip fracture patients to ameliorate its short- and long-term effects on functional outcomes.

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