Preoperative Cognitive Impairment and Psychological Distress in Hospitalized Elderly Hip Fracture Patients

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Abstract

We conducted a prospective study to evaluate the prevalence of cognitive impairment (CI) in elderly inpatients awaiting surgery for hip fracture, and to compare CI and normal cognition (NC) patients with respect to preoperative pain, fear, and anxiety.

The study included patients who were older than 65 years when admitted to a hospital after acute hip fracture. Preoperative assessment involved use of Confusion Assessment Method–Short Form, Montreal Cognitive Assessment (MoCA), visual analog scales for anxiety and fear, and Wong-Baker Faces Pain Scale. Patients with delirium were excluded from the study. Patients with CI and NC, as determined by MoCA score, were compared for each assessment.

Of the 65 hip fracture patients enrolled, 62 had evaluable cognitive data. Of these 62 patients, 23 (37.1%) had NC (MoCA score, ≥ 23) and 39 (62.9%) had CI (MoCA score, < 23). Only 5 (7.7%) of the 65 patients had a documented diagnosis of CI or dementia at time of hospitalization. Mean preoperative pain scores were significantly ($P < .001$) higher for CI patients (5.3) than for NC patients (2.8).

Our study results showed that many elderly hip fracture patients had unrecognized CI before surgery, and CI patients had significantly more pain than NC patients did. Appropriate identification of preoperative CI and treatment of pain are crucial in optimizing patient outcomes.

Hip fracture is a major cause of morbidity and mortality in the elderly population, with reported 1-year mortality rates as high as 40%.[1-4] The year after hip fracture is often associated with decreases in independence, mobility, and overall daily function.[3,4]

Cognitive impairment (CI) is a well-described risk factor for injurious falls in advanced age. Therefore, it would be expected that chronic cognitive disorders, such as dementia and Alzheimer disease, are highly prevalent in hip fracture populations. However, it is difficult to estimate the underlying frequency of preoperative cognitive disorders in this population, as dementia is generally underreported in inpatient settings. Observed rates of documented dementia diagnoses in hip fracture patients vary widely, from 15% to 32%.[5-7]

Dementia is characterized by deficits in multiple cognitive domains (memory, language, executive function) and functional impairment.[8] Alzheimer disease is the most common degenerative dementia encountered in hospital and outpatient settings.[7] Although a feature of all dementia subtypes, CI is not pathognomonic for dementia, but is a general term for deficits in 1 or more domains of cognitive functioning that arise from psychiatric or neurologic disease, brain injury, or iatrogenic origins (eg, adverse drug effect). As expected, CI is more prevalent than dementia among the hospitalized elderly, with reported rates of up to 85%.[7,9-12]

Recent evidence linking cognitive function with postoperative patient outcomes[4,12,13] has highlighted the fact that preoperative recognition of CI is crucial to effective management of hip fractures in elderly patients.[2,14] Bedside attempts to assess hip fracture patients for cognitive deficits often fail, in part because standardized mental status screening examinations are not commonly used in patients with acute orthopedic conditions, such as hip fracture.

The Mini Mental State Examination (MMSE) screening tool is widely used in clinical and research settings to identify CI in hospitalized patients, including hip fracture patients.[12,15,16] However, the well-documented MMSE ceiling effect may result in underestimation of CI, particularly in more highly educated patients and in patients with mild CI, an important risk factor for progression to Alzheimer disease. Compared with the

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MMSE, the Montreal Cognitive Assessment (MoCA), a validated rapid-screening instrument used to detect mild cognitive dysfunction, has higher sensitivity and specificity.[17-19] MoCA has been used to assess for CI in normative populations[20,21] and in cardiac,[22,23] infectious disease,[23] stroke,[24] and Parkinson[25] patients but has not been used to specifically identify CI in hip fracture patients.

The period immediately before hip fracture surgery is often extremely stressful, and may be marked by fear and anxiety, especially for CI patients.[26] Although not a common or routine part of preoperative assessment, determination of elderly hip fracture patients' fear and anxiety levels is important, as anticipatory distress states may influence postoperative outcomes.[14,26,27]

To our knowledge, there has not been a systematic assessment of the prevalence of CI and psychological distress in elderly patients about to undergo hip fracture repair. We conducted a prospective study to determine the prevalence of CI in hip fracture patients, and to compare the pain, fear, and anxiety levels of CI and normal cognition (NC) patients. Our hypotheses were that preoperative cognitive assessment with an instrument sensitive to mild degrees of CI would reveal a high degree of undocumented CI, and that, compared with patients with less CI, patients with more CI would have higher pain, anxiety, and fear levels before hip fracture surgery.

Materials and Methods

This article is based on baseline data from CAFE (Cognitive Assessment After Hip Fracture in the Elderly), an ongoing prospective longitudinal study. This longitudinal arm of the study is examining postoperative cognitive change, functional abilities, psychological distress, and rehabilitation outcomes in elderly patients hospitalized for hip fracture surgery. The effort is a collaboration between the Departments of Orthopaedic Surgery, Neurology (Alzheimer's Disease and Memory Disorders Center), Psychiatry, and Quality Management at Rhode Island Hospital (RIH). CAFE study design and informed-consent procedures were reviewed and approved by the institutional review board at RIH.

English-speaking patients who were 65 years or older when admitted to RIH after an acute intracapsular or extracapsular hip fracture between August 2011 and August 2012 were eligible to participate in the study. Those with pathologic hip fracture, alcohol dependence, CI secondary to cerebral vascular accident, unstable psychiatric disorder, or delirium were excluded, as were patients unable to give informed consent. For the study, the orthopedic house officer identified patients who presented with a hip fracture to the emergency department and who fulfilled the inclusion criteria. Written informed consent was obtained from all who agreed to participate in the study.

Preoperative Assessments

Multiple psychometric tests were administered to each patient (**Table I**). Delirium was assessed with the Confusion Assessment Method–Short Form (CAM–SF), also known as the Brief CAM (bCAM), and documented by the attending physician. CAM–SF, a commonly used diagnostic algorithm for identification of delirium, specifically assesses for presence of acute onset of CI, fluctuating course, inattention, disorganized thinking, and altered level of consciousness.[28,29] A diagnosis of delirium is made when the first 3 test items are positive and item 4 or item 5 are positive as well. Hip fracture patients who had a preoperative diagnosis of delirium or who met the CAM–SF delirium criteria were not enrolled.

MoCA, a rapid-screening instrument for preoperative cognitive assessment, was used to determine CI presence and severity. One point was added to the Total score for patients who reported having fewer than 12 years of formal education.[18] Patients with a preoperative MoCA Total score of 23 points or more were deemed to have NC, and those with a preoperative MoCA Total score of less than 23 points were deemed to have CI.[21]

Table I. Preoperative Psychometric Tests Administered for CAFE (Cognitive Assessment After Hip Fracture in the Elderly) Study

Confusion Assessment Method–Short Form (CAM-SF)
Montreal Cognitive Assessment (MoCA)
Zuckerman Activity Scale
Short Form–12 Functional Status Assessment
Wong-Baker Faces Pain Scale
Visual analog scale (VAS) for anxiety
Visual analog scale (VAS) for fear
Impact of Event Scale
Eight Question Screen Test

Also administered to each patient were a visual analog scale (VAS) for anxiety, a VAS for fear, and the Wong-Baker Faces Pain Scale. These sensitive and reliable tests are used to evaluate anxiety, fear, and pain in CI and NC patients.[30] The VAS instructions are to indicate a point on a line to show one's anxiety level before surgery; the same is done for fear. The line is 100 mm long, with 0 mm indicating absence of anxiety (fear) and 100 mm indicating extreme anxiety (fear). On the Wong-Baker Faces Pain Scale, patients point to a face that best describes their pain intensity, with face 0 indicating no pain and face 10 indicating worst possible pain.

Preoperative assessments were made in the emergency department, inpatient ward, or preoperative care unit by the orthopedic house officer. Perioperative variables, including age, sex, medical comorbidity, presence of CI or dementia, fracture type, anesthesia type (general or spinal), surgery duration, postoperative delirium, and hospital length of stay (LOS), were extracted from the medical record after discharge. Information regarding history of prior falls and place of residence at time of fall was also documented.

Statistical Analysis

Data were analyzed with Stata 10.0 (StataCorp, College Station, Texas). Preoperative demographics, comorbidities, symptom rating scores, and hospital LOS were summarized for the study population. Group differences for CI and NC patients were compared using χ^2 or Fisher exact test (categorical variables) and Student t test or 1-way analysis of variance (continuous measures). All comparisons were 2-sided, and significance was set a priori at $\alpha = 0.05$, with Bonferroni corrections for multiple post hoc comparisons. There was no imputation of missing values.

Results

Sample Characteristics

Of the 122 eligible hip fracture patients, 65 (53.3%) were enrolled (**Table II**). Reasons for nonenrollment included patient refusal to participate and inability to collect data before surgery. The 65-patient cohort consisted of 46 women (70.8%) and 19 men (29.2%). Mean (SD) age was 82.5 (7.6) years (range, 66 to 97 years), and mean (SD) number of years of education was 12.6 (1.8). All 65 patients underwent hip fracture surgery with either fixation or arthroplasty. No in-hospital deaths occurred in this cohort.

Preoperative Cognitive Assessment

Of the 65 subjects enrolled in the study, 62 had evaluable cognitive data. On average, mild or moderate preoperative CI was observed across the study population. Mean (SD) MoCA Total score was 19.3 (6.8) points (median, 21.0 points; range, 3 to 30 points).

The cohort was divided into 2 cognitive subgroups: NC and CI. Twenty-three patients (37.1%) scored in the NC range (mean MoCA Total score, 25.7 points; SD, 2.1 points; median, 26.0 points; range, 23 to 30 points), and 39 patients (62.9%) scored in the CI range (mean MoCA Total score, 15.5 points; SD, 5.7 points; median, 16 points; range, 3 to 22 points). A diagnosis of dementia or CI was infrequently documented in the medical record. Five (7.7%) of the entire group of 65 patients and 5 (12.8%) of the 39 CI patients had a documented diagnosis of CI or dementia during hospitalization (**Figure 1**). None of the 23 patients who scored more than 23 points on MoCA had a diagnosis of CI or dementia.

There were no statistically significant differences in age, sex, education level, place of residence, medical comorbidities, current smoking or alcohol use, history of prior fall, anxiety diagnosis, or depression diagnosis between CI and NC patients. However, there was a trend ($P = .07$) toward higher depression prevalence in the CI group (**Table II**). Before the hip fracture, 18 (46.2%) of the 39 CI patients and 10 (43.5%) of the 23 NC patients lived alone, $\chi^2(1, N = 62) = 0.42$ ($P = .84$). Thirteen (56.5%) of the 23 NC patients were married, compared with 10 (25.6%) of the 39 CI patients, $\chi^2(1, N = 62) = 5.9$ ($P = .02$).

Preoperative Pain and Psychological Distress

CI patients' MoCA Total scores varied widely (range, 3 to 22), reflecting cognitive dysfunction ranging from very mild to severe. Self-reported preoperative pain, anxiety, and fear ratings were first compared between CI and NC patients (**Table II**), then across quartiles (Qs) of MoCA Total scores (**Table III**). Only the 61 patients with evaluable pain and symptom ratings were included in these analyses.

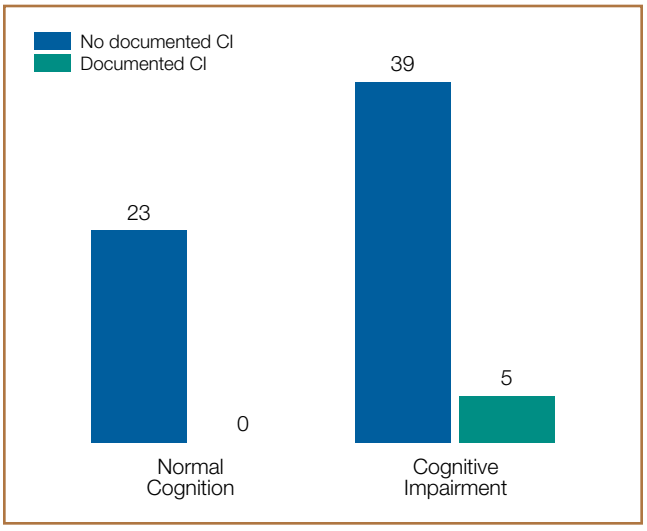

Figure 1. Documented cognitive impairment (CI) or dementia in medical records of study patients.

CI patients' preoperative Wong-Baker Faces Pain Scale scores (mean, 5.3; SD, 2.8) were higher ($P < .001$) than NC patients' (mean, 2.8; SD, 1.6), and pain ratings differed significantly across CI quartiles, $F(3, 57) = 4.88$ ($P < .01$) (**Figure 2**). Bonferroni post hoc comparisons indicated that patients with the most severe CI had higher degrees of preoperative pain than patients with the least CI (Q1 or Q2 vs Q4; $P < .05$). Before cognitive assessment, 30.4% of NC patients and 17.9% of CI patients had received pain medication ($P = .28$).

CI patients' mean (SD) VAS anxiety score was 56.2 (35.5), not significantly different ($P = .52$) from NC patients' mean (SD) score, 50.0 (38.3). Although the VAS anxiety score for patients with the most severe CI (Q1 mean, 70.7; SD, 30.2) was considerably higher than the score for NC patients (Q4 mean, 47.8; SD, 40.9), there were no differences in preoperative anxiety scores across CI quartiles, $F(3, 57) = 1.48$ ($P = .23$).

NC and CI patients' preoperative ratings of fearfulness were similar. Mean (SD) VAS fear score was 40.0 (31.7) for NC patients and 41.6 (37.7) for CI patients ($P = .87$). However, this measure differed significantly across CI quartiles, $F(3, 57) = 4.82$ ($P < .01$). Patients with the most severe CI rated higher degrees of preoperative fear than patients with less CI (Q1 vs Q2; $P < .01$), and there was a trend for higher VAS fear scores when patients with the most severe CI were compared with NC patients (Q1 vs Q4; $P = .05$).

Discussion

This study found that CI in hip fracture patients is infrequently documented in the medical record. In this prospective investigation, we found that more than 62% of hip fracture patients

Table II. **Preoperative Characteristics of Hip Fracture Patients**

Characteristics	Cohort (N = 65)	NC (n = 23)	CI (n = 39)	*P*[a]
Sociodemographics				
Age, y				
Mean (SD)	82.5 (7.6)	81.2 (7.0)	82.8 (7.5)	.40
Range	66-97	66-93	67-97	.40
Sex, % female	70.8	73.9	69.2	.70
Mean (SD) no. of years of education	12.6 (1.8)	13.0 (1.8)	12.5 (1.6)	.20
Married, %	37.1	56.5	25.6	.02
Lives alone, %	41.5	43.5	46.2	.84
Medical Comorbidities, %				
History of coronary artery disease	27.4	26.1	28.2	.86
History of hypertension	87.1	82.6	89.7	.33
History of diabetes	27.4	30.4	25.6	.68
History of chronic obstructive pulmonary disease	1.6	0.0	2.6	.63
History of cancer	29.0	34.8	25.6	.44
History of osteoarthritis	17.7	13.0	20.5	.35
Depression diagnosis	26.2	13.0	33.3	.07
Dementia diagnosis	7.7	0.0	12.8	.09
History of prior fall	61.5	56.5	61.5	.69
Preoperative Assessments				
MoCA Total score, points	18.2 (8.1)	25.7 (2.1)	15.5 (5.7)	< .001
CAM–SF Total score, points	0.4 (0.1)	0.27 (0.76)	2.5 (1.9)	.10
Wong-Baker Faces Pain Scale rating, points	4.3 (2.7)	2.8 (1.6)	5.3 (2.8)	< .001
VAS score for anxiety, mm	53.8 (36.4)	50 (38.3)	56.2 (35.5)	.52
VAS score for fear, mm	40.6 (35.3)	40 (31.7)	41.6 (37.7)	.87
Postoperative Characteristics				
Delirium, %	10.8	4.3	10.5	.37
Mean (SD) hospital LOS, d	6.3 (4.5)	5.6 (4.4)	6.7 (4.7)	.39

Abbreviations: CAM–SF, Confusion Assessment Method–Short Form; CI; cognitive impairment; LOS, length of stay; MoCA, Montreal Cognitive Assessment; NC, normal cognition; VAS, visual analog scale.
[a]Comparisons between normal cognition group and cognitive impairment group.

had CI, but CI or dementia was recognized on admission by staff in less than 10% of patients. Compared with NC patients awaiting surgery, patients with the most severe CI reported more severe pain, and their ratings of preoperative psychological distress suggested a trend for more anticipatory fearfulness in this group.

Ideally, CI should be identified before surgery. Instituting procedures to screen for CI and accurately assess discomfort levels before surgery may improve preoperative pain management, which may have implications for postoperative outcomes in hip fracture patients.[4,13] Despite our small sample size, we found a significant difference in pain between CI and NC patients. CI patients may be undermedicated with potent analgesics for fear of causing delirium, or they may be too impaired to advocate for their needs. However, recent evidence suggests that CI patients can be medicated with opiates safely and that uncontrolled pain may actually increase the risk for delirium.[31] Our CI patients also had a higher incidence of depression, which commonly accompanies dementia.[32,33] This comorbid factor, another potentially treatable modifier of anxiety, could influence outcomes.

Recent evidence has shown that, after discharge, the impact

Table III. Preoperative Ratings of Cognitive Function, Pain, and Psychological Distress According to MoCA Quartiles[a]

Rating Scale, mean (SD)	Quartile 1 (n = 15)	Quartile 2 (n = 19)	Quartile 3 (n = 12)	Quartile 4 (n = 15)
MoCA Total score, points	10.2 (3.5)	18.9 (2.3)	23.0 (0.85)	26.9 (1.5)
Wong-Baker Faces Pain Scale rating, points	5.2 (2.8)	5.6 (2.9)	3.5 (2.3)	2.6 (1.4)[b]
VAS score for anxiety, mm	70.7 (30.2)	47.2 (37.4)	50.7 (32.9)	47.8 (40.9)
VAS score for fear, mm	64.8 (37.0)	24.7 (29.5)[c]	47.3 (34.3)	32.6 (29.0)[c]

Abbreviations: MoCA, Montreal Cognitive Assessment; VAS, visual analog scale.

[a]Sixty-one patients had evaluable cognitive, pain, and symptom ratings. Data are means (SDs).
[b]Quartile 1 versus quartile 4 ($P < .05$); quartile 2 versus quartile 4 ($P < .05$).
[c]Quartile 1 versus quartile 2 ($P < .01$); quartile 1 versus quartile 4 ($P = .05$).

of preoperative cognitive deficits on hip fracture outcomes is not benign. Schaller and colleagues[12] found that mild or moderate CI was associated with a more than 5-fold increase in the mortality rate and a 7-fold increase in nursing home admissions 1 year after hip fracture. In addition, functional outcomes are worse at 2-year follow-up for CI patients than for NC patients.[34] Furthermore, family members of CI patients reported powerlessness and sadness after hip fracture, as compared with the generally positive experiences of family members of NC patients after hip fracture.[35]

In this investigation, more than 45% of CI patients lived alone, and there was a substantial difference in marital status between the cognitive subgroups, with CI patients being less likely to be married. These findings have important implications for aftercare, as familial and social support is important for optimal postoperative outcomes.[13]

Numerous ongoing trials are aimed at improving geriatric hip fracture care. These studies often exclude patients with dementia and CI. The FAITH (Fixation Using Alternative Implants for the Treatment of Hip Fractures) study compares sliding hip screws and cancellous screws for femoral neck fractures. As of December 2010, this study had a 78% exclusion rate; 22.2% of the exclusions were because of dementia or CI.[36] The high number of patients excluded because of CI is an important consideration when interpreting the results of these studies, given the high background rates of CI in hip fracture populations.

Another consideration when evaluating cognitive function in hip fracture patients is selection of an instrument adequately sensitive to detect mild but clinically significant levels of impairment. Notably, the present study is the first to use MoCA to evaluate preoperative hip fracture patients. Although MMSE has been used to screen for CI in most large studies of hip fracture outcomes,[36] it may be relatively insensitive to cognitive dysfunction compared with MoCA and may not be optimal for assessing preoperative patients for CI. We used a modified 23-point cutoff (vs the original 26-point cutoff) to optimize sensitivity and specificity of MoCA. The 23-point scoring cutoff yields about 96% sensitivity and 95% specificity for distinguishing Alzheimer disease or mild CI patients from NC patients.[21]

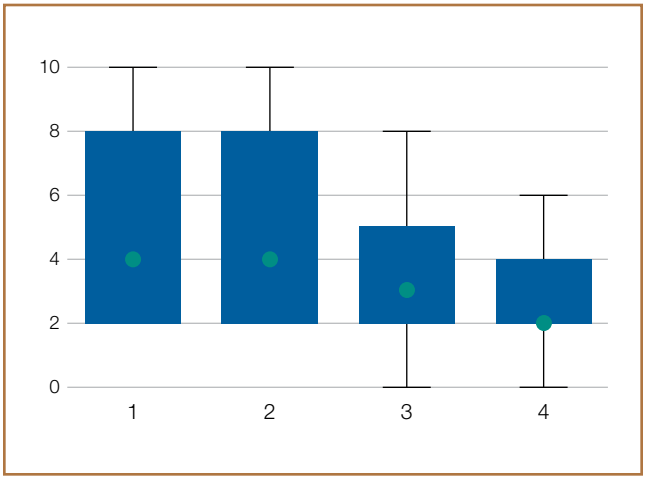

Figure 2. Sixty-one patients had evaluable preoperative pain ratings, presented here by MoCA quartiles: quartile 1, patients with most CI; quartile 4, patients with NC. Green circle indicates median score within quartile.

This study has several limitations. Our enrollment rate of 53% leaves open the possibility of recruitment bias in this cohort, and more data on reasons for refusal to participate are needed. This study was performed at a single site and may not reflect the patient population and standard of care provided at other institutions. Also, under the study protocol, there was no examination of interrater or test–retest reliability. Furthermore, the small sample size may indicate that this study was underpowered, and no formal power analysis was conducted to assess this presumption. Lack of posthospitalization outcome data in this investigation may also be considered a limitation. However, these in-hospital data are of value. Monitoring of this cohort to assess outcomes is ongoing, and the data will be reported when available. Last, the stress of hip fracture and mild undetected delirium may influence cognitive testing. Therefore, future studies should examine cohorts with preinjury cognitive baseline data.

On the basis of our study results, several changes have been made to the hip fracture service at our institution. We have adopted an orthogeriatrics service, which screens patients for

CI and adjusts treatment for patients based on individual needs. We have also instituted protocol changes aimed at improving pain control in CI patients. In addition, there is ongoing follow-up of this cohort to evaluate patient outcomes related to preoperative CI and psychological factors.

Conclusion

This cross-sectional cohort observation study revealed that more than 60% of elderly hip fracture patients had CI before surgery, but less than 10% carried a documented preoperative diagnosis of CI or dementia on arrival at the hospital. Furthermore, compared with NC patients, patients with severe CI had significantly more pain and fear. Appropriate identification of preoperative CI and appropriate pain treatment are crucial in optimizing patient outcomes.

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This paper will be judged for the Resident Writer's Award.