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Predictors and Sequelae of Postoperative Delirium in Geriatric Hip Fracture Patients

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Abstract

Introduction: Perioperative delirium in elderly hip fracture patients has been correlated with significant morbidity. The purpose of this study was to determine the preoperative risk factors for and short-term sequelae of postoperative delirium in geriatric hip fracture patients. **Methods:** We queried the American College of Surgeons National Surgical Quality Improvement Program to identify geriatric ($\geq$65 years) patients who sustained operative hip fractures in 2016. Cohorts of patients with and without documented postoperative delirium were identified. Primary data on patient demographics and comorbidities were collected and correlated with postoperative complications and hip fracture outcome measures. Multivariate regression was used to compute risk-adjusted odds ratios (OR) of risk factors and sequelae of delirium. **Results:** In total, 8,439 geriatric hip fracture patients were identified of whom 2,569 patients (30.4%) had postoperative delirium. Age (OR 1.03 [1.02-1.04, $p < 0.001$), white race (OR 1.54 [1.19-2.00], $p = 0.001$), American Society of Anesthesiologists classification (OR 1.20 [1.07-1.36], $p = 0.003$), baseline dementia (OR 2.46 [2.11-2.86], $p < 0.001$), and preoperative delirium (OR 10.06 [8.12-12.45], $p < 0.001$) were independent risk factors for postoperative delirium in multivariate analysis. Patients with postoperative delirium had a significantly higher risk-adjusted 30-day mortality (12.0% vs. 4.8%, OR 2.22 [1.74-2.84], $p < 0.001$) and morbidity profile. Postoperative delirium was also independently associated with higher rates of discharge to (OR 1.65 [1.32-2.06], $p < 0.001$) and prolonged stay in (OR 1.79 [1.53-2.09], $p < 0.001$) an inpatient facility, hospital readmission (OR 1.94 [1.58-2.38], $p < 0.001$) and hospital length of stay (7.6 $\pm$ 5.0 vs. 6.1 $\pm$ 4.1 days, $p < 0.001$), as well as lower rates of immediate postoperative weight bearing (OR 0.73 [0.63-0.86], $p < 0.001$). **Discussion:** Postoperative delirium is a common occurrence in geriatric hip fractures with multiple risk factors. Delirium portends higher mortality and worse perioperative hospital-based outcomes. **Conclusions:** Multidisciplinary foreknowledge and management efforts are warranted to mitigate the risk of developing delirium, which strongly predicts perioperative morbidity, mortality, and hip fracture outcomes.

Keywords
delirium, trauma surgery, geriatric trauma, fragility fractures, systems of care

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Introduction

With an aging population, the number of geriatric hip fractures continues to rise in the United States, with estimates of up to 400 000 hip fractures per year occurring over the next decade.[1,2] Hip fractures represent a significant financial burden to patients and the health-care system with US$10.3 to US$15.2 billion dollars spent annually in the United States.[3] The total cost of hip fracture care in the United States is estimated to reach US$62 billion annually by 2040. Adding to these expenditures, delirium is a known postoperative complication occurring in 4% to 65% of all geriatric hip fractures.[4-6] Postoperative delirium has been associated with sequelae of poorer outcomes, increased length of hospital stay, costs, and mortality.[7-11] Zywiel et al found that postoperative delirium for geriatric hip fractures was associated with an increased length of stay (LOS) of 7.4 days postoperatively and a mean incremental episode-of-care cost of close to US$7000.[9] Furthermore, in a large meta-analysis of geriatric hip fractures, Liu

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et al discovered that patients with postoperative delirium had more than twice the risk of death than those without.[7]

Known risk factors for delirium in postoperative patients include modifiable factors such as use of physical restraints, opioids, polypharmacy, general anesthesia, indwelling urinary catheters, active infections, and number of hours mobilized.[4,12-14] Potential nonmodifiable risk factors include patient age, male gender, history of dementia, and American Society of Anesthesiologists (ASA) classification.[10,15] Choi et al found that older patients and those who underwent general instead of spinal anesthesia were 1.5 times and 2 times more likely to develop postoperative delirium, respectively.[4] Edelstein et al also discovered that male and ASA class 3 or 4 patients were 2 times more likely to develop delirium in the postoperative period after geriatric hip fracture surgery.[10] Despite many published studies on potential preoperative risks for postoperative delirium, the majority of studies are usually limited to a single institution with a small cohort of patients.

As high as 30% to 40% of delirium cases during acute hospitalization can be prevented by the treatment of preoperative risk factors in the geriatric population.[16] Identifying these risks may help providers reduce costs, morbidity, and mortality in geriatric hip fractures. The purpose of this study was to identify preoperative predictors and sequelae of postoperative delirium in geriatric hip fractures using a large patient sample across multiple institutions. Our hypothesis was that postoperative delirium increases perioperative morbidities, surgical complications, hospital LOS, discharge to inpatient facility, hospital readmissions, and mortality in geriatric hip fractures.

Materials and Methods

We performed a retrospective review of the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database. The ACS NSQIP is a prospective, multi-institutional program that collects perioperative data on over 150 patient variables from over 500 NSQIP-participating hospitals in the United States. Reported data are acquired from medical records, operative reports, and patient interviews by trained clinical reviewers and are compliant with the Health Insurance Portability and Accountability Act. The series undergoes routine auditing, which ensures high-quality data with reported interrater disagreement of less than 2.3% for all variables. Data are collected up to postoperative day (POD) 30 and include information following hospital discharge.

Geriatric patients ($\geq$65 years) who underwent operative fixation of femoral neck, intertrochanteric, and subtrochanteric hip fractures in 2016 were identified using the Targeted Hip Fracture participant utilization file, which collects hip fracture-specific data in addition to the standard reported variables. Hip fracture patients were divided into 2 cohorts based on whether or not they had documented postoperative delirium. Patient characteristics collected from the registry included patient age, sex, height, weight, smoking history (within 1 year), ASA class, and medical comorbidities including diabetes, dementia, chronic obstructive pulmonary disorder (COPD), liver disease with ascites, congestive heart failure (CHF), hypertension (HTN), and dialysis-dependent kidney disease. Data on documented preoperative delirium were also recorded. Body mass index (BMI) was calculated for each patient's height and weight. Functional status was defined as the patient's ability to perform the activities of daily living either independently or in a partially or completely dependent manner within the 30 days prior to admission.

Data on postoperative medical complications within 30 days were collected and included deep vein thrombosis (DVT), pulmonary embolism (PE), pneumonia, acute renal failure, urinary tract infection (UTI), cardiac arrest, myocardial infarction (MI), cerebrovascular accidents (CVAs), and sepsis. Surgical complication data on postoperative superficial and deep surgical site infection (SSI), reoperation, and blood transfusion were also collected for both cohorts. Hip fracture–specific outcomes data collected included discharge destination (home vs facility), hospital readmission, total hospital LOS, and whether patients were weight bearing as tolerated (WBAT) on POD1.

Descriptive statistics and comparison of baseline characteristics were performed using χ^2 testing for categorical variables, independent samples *t* test for continuous variables, and independent samples median test with Yates' continuity correction for age. Multivariate logistic regression was also used to determine the relationship between postoperative and binary medical complications, surgical complications, and hip fracture outcomes. Baseline patient age, gender, race, BMI, functional status, ASA classification, comorbidities, and preoperative delirium and/or dementia were used as covariates to compute risk-adjusted odds ratio (OR) for each variable. Patients with postoperative delirium were treated as the exposed group and patients without postoperative delirium were treated as the control group. Multivariate linear regression was similarly used to assess the risk-adjusted relationship between postoperative delirium and hospital LOS. Standardized OR, 95% confidence intervals, and *P* values were computed using the methods described by Bland et al.[17] Statistical significance was defined as $P < .05$ and all statistical analyses were performed using SPSS 21 software (IBM Corp, Armonk, New York).

Results

The query identified a total of 8439 geriatric patients who had operative fixation of femoral neck, intertrochanteric, or subtrochanteric hip fractures in 2016 in the NSQIP series. Of these, 2569 had documented postoperative delirium corresponding to an incidence of 30.4%. The median age was 86 years in patients who developed postoperative delirium versus 84 years in those who did not develop postoperative delirium ($P < .001$; Table 1). Of the total cohort, 71.5% were female, 93.7% were white, and 77.0% were independent in their activities of daily living at baseline. Among hip fractures treated, 38.4% involved the femoral neck, 55.3% involved the intertrochanteric region, and 6.3% involved the subtrochanteric region. In univariate analysis, baseline age ($P < .001$), race ($P < .001$), functional health status ($P < .001$), and ASA classification ($P < .001$) were

Table 1. Comparison of Baseline Demographics and Characteristics of Geriatric Hip Fracture Patients With and Without Postoperative Delirium.[a]

Baseline Characteristic	Postoperative Delirium (n = 2569)	No Postoperative Delirium (n = 5870)	*P* Value
Age (years, median)[b]	86	84	<.001
Female (%)	70.5%	71.9%	.164
White (%)	92.8%	94.6%	.003
Body mass index (BMI)[c]	24.3 ± 5.5	25.1 ± 5.6	.084
Functional health status			<.001
Independent	63.5%	82.8%	
Partially dependent	31.7%	14.7%	
Totally dependent	4.8%	2.5%	
ASA classification (continuous)[c]	3.2 ± 0.6	3.0 ± 0.6	<.001
ASA classification (ordinal)			<.001
1	0.2%	0.4%	
2	8.4%	16.8%	
3	63.2%	62.2%	
4	28.0%	20.5%	
5	0.2%	0.1%	
Dementia (%)	54.4%	21.4%	<.001
Preoperative delirium (%)	33.9%	3.5%	<.001
Diabetes (%)	16.4%	18.1%	.061
Smoker, current (%)	7.4%	8.9%	.054
COPD (%)	11.5%	10.4%	.111
Ascites (%)	0.2%	0.3%	.431
CHF (%)	5.0%	3.7%	.005
Hypertension (%)	70.5%	68.4%	.060
Dialysis (%)	1.8%	1.7%	.778
Hip fracture pattern			.060
Femoral neck	39.1%	38.1%	
Intertrochanteric	55.9%	55.0%	
Subtrochanteric	5.0%	6.9%	

Abbreviations: ASA, American Society of Anesthesiologists; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease.
[a]All other comparisons performed using χ^2 analysis.
[b]Statistical comparison performed using independent samples median test.
[c]Statistical comparison performed using independent sample *t* test.

significantly different at baseline between the 2 cohorts. The cohort of patients with postoperative delirium also had a higher baseline incidence of dementia ($P < .001$), preoperative delirium ($P < .001$), and CHF ($P = .005$). Baseline BMI and other medical comorbidities were statistically comparable between the 2 cohorts (Table 1).

Multivariate logistic regression analysis showed that age (OR: 1.03 [1.02-1.04]; $P < .001$), white race (OR: 1.54 [1.19-2.00]; $P = .001$), ASAs classification (OR: 1.20 [1.07-1.36]; $P = .003$), baseline dementia (OR: 2.46 [2.11-2.86]; $P < .001$), and preoperative delirium (OR: 10.06 [8.12-12.45]; $P < .001$) were independent risk factors for postoperative delirium (Table 2). Sex, BMI, functional health status, hip fracture pattern, and individual medical comorbidities including diabetes, smoking, COPD, ascites, CHF, HTN, and dialysis-dependent kidney disease were not independent risk factors for postoperative delirium.

Table 2. Assessment of Risk Factors for Postoperative Delirium Using Multivariate Logistic Regression.

Covariate	OR (95% CI)	*P* Value
Age	1.03 (1.02-1.04)	<.001
Sex (female)	0.88 (0.76-1.03)	.102
Race (non-white)	0.65 (0.50-0.84)	.001
Body mass index (BMI)	1.00 (0.99-1.01)	.780
Functional health status		
Partially dependent	0.84 (0.57-1.23)	.367
Totally dependent	1.29 (0.87-1.92)	.210
ASA classification	1.20 (1.07-1.36)	.003
Dementia	2.46 (2.11-2.86)	<.001
Preoperative delirium	10.06 (8.12-12.45)	<.001
Diabetes	0.99 (0.83-1.19)	.917
Smoking	1.14 (0.88-1.48)	.334
COPD	1.10 (0.89-1.36)	.395
Ascites	0.57 (0.11-3.05)	.514
CHF	1.11 (0.81-1.53)	.522
Hypertension	1.07 (0.92-1.25)	.374
Dialysis	1.22 (0.75-1.96)	.430
Hip fracture pattern		
Intertrochanteric vs femoral neck	1.09 (0.80-1.50)	.583
Subtrochanteric vs femoral neck	1.16 (0.85-1.58)	.349

Abbreviations: ASA, American Society of Anesthesiologists; CI, confidence interval; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; OR, odds ratio.

Multivariate logistic regression revealed that patients with postoperative delirium had a significantly higher risk-adjusted 30-day mortality (12.0% vs 4.8%, OR: 2.22 [1.74-2.84]; $P < .001$; Table 3). Postoperative delirium was also independently associated with higher coincidence of postoperative pneumonia (7.6% vs 2.8%, OR: 2.93 [2.15-4.01]; $P < .001$), UTI (6.0% vs 4.3%, OR: 1.60 [1.16-2.19]; $P = .004$), CVA (1.6% vs 0.7%, OR: 3.04 [1.73-5.37]; $P < .001$), MI (4.5% vs 2.3%, OR: 2.95 [2.01-4.34]; $P < .001$), and sepsis (1.9% vs 0.7%, OR: 2.50 [1.36-4.56]; $P = .003$) within 30 days postoperatively. Rates of DVT, PE, acute renal failure, and cardiac arrest were comparable between patients with and without postoperative delirium. All queried surgical complications including SSI, reoperation, and blood transfusion occurred at comparable rates. Postoperative delirium was also independently associated with higher rates of discharge to inpatient facility (OR: 1.65 [1.32-2.06]; $P < .001$), residence at inpatient facility at 30 days (OR: 1.79 [1.53-2.09]; $P < .001$), and hospital readmission within 30 days (OR: 1.94 [1.58-2.38]; $P < .001$; Table 4). Mean hospital LOS was higher for patients with postoperative delirium (7.6 ± 5.0 vs 6.1 ± 4.1 days; $P < .001$). Patients with postoperative delirium were also less likely to comply with WBAT order immediately postoperatively (OR: 0.73 [0.63-0.86]; $P < .001$).

Discussion

Fragility hip fractures represent a significant socioeconomic burden associated with increased mortality. Postoperative delirium in these patients is a common occurrence correlated

Table 3. Perioperative Complications and Sequelae Associated With Delirium in Geriatric Hip Fracture Patients.

Complications (Within 30 Days)	Postoperative Delirium (n = 2569)	No Postoperative Delirium (n = 5870)	Adjusted OR (for Patients With Postoperative Delirium)[a]	*P* Value
Medical complications				
Death	12.0%	4.8%	2.22 (1.74-2.84)	<.001
Deep vein thrombosis (DVT)	1.5%	1.2%	1.54 (0.91-2.60)	.111
Pulmonary embolism	0.9%	0.7%	1.28 (0.59-2.79)	.532
Pneumonia	7.6%	2.8%	2.93 (2.15-4.01)	<.001
Acute renal failure	4.7%	2.2%	2.64 (0.98-7.13)	.055
Urinary tract infection	6.0%	4.3%	1.60 (1.16-2.19)	.004
Cerebrovascular accident	1.6%	0.7%	3.04 (1.73-5.37)	<.001
Cardiac arrest	1.0%	0.6%	1.35 (0.68-2.65)	.393
Myocardial infarction	4.5%	2.3%	2.95 (2.01-4.34)	<.001
Postoperative sepsis	1.9%	0.7%	2.50 (1.36-4.56)	.003
Surgical complications				
Superficial SSI	0.7%	0.4%	2.03 (0.62-6.64)	.241
Deep SSI	0.3%	0.1%	2.22 (0.35-14.11)	.397
Reoperation	2.9%	2.0%	1.57 (0.91-2.38)	.073
Transfusion	29.7%	27.6%	1.09 (0.94-1.27)	.241

Abbreviations: ASA, American Society of Anesthesiologists; OR, odds ratio; SSI, surgical site infection.
[a]Adjusted OR computed using multivariate logistic regression with age, gender, BMI, preoperative delirium, dementia, comorbidities, and ASA classification as covariates.

Table 4. Hip Fracture Outcome Measures in Patients With Delirium Following Geriatric Hip Fracture.

Outcome Measure[a]	Postoperative Delirium (n = 2569)	No Postoperative Delirium (n = 5870)	Adjusted OR (for Patients With Postoperative Delirium)[a]	*P* Value
Discharge to inpatient facility	84.5%	81.0%	1.65 (1.32-2.06)	<.001
Inpatient facility at 30 days	57.0%	38.9%	1.79 (1.53-2.09)	<.001
Hospital readmission	11.8%	6.6%	1.94 (1.58-2.38)	<.001
WBAT on POD1	65.4%	76.9%	0.73 (0.63-0.86)	<.001
Outcome Measure[b]	**Postoperative Delirium (n = 2569)**	**No Postoperative Delirium (n = 5870)**	**Coefficient (B) (for Patients With Postoperative Delirium)¥**	***P* Value**
Total hospital LOS (days)	7.6 ± 5.0	6.1 ± 4.1	1.25 (1.05-1.45)	<0.001

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; LOS, length of stay; OR, odds ratio; POD1, postoperative day 1; WBAT, weight bearing as tolerated.
[a]Adjusted OR computed using multivariate logistic regression with age, gender, BMI, preoperative delirium, dementia, comorbidities, and ASA classification as covariates.
[b]Adjusted OR computed using multivariate linear regression with age, gender, BMI, preoperative delirium, dementia, comorbidities, and ASA classification as covariates.

with increased LOS and significant morbidity and mortality.[7,9] Although preoperative risk factors for delirium following hip fractures have previously been researched, most studies have focused on a single institution covering a much smaller cohort of patients and a narrower scope of reported outcomes. The purpose of this study was to identify preoperative risk factors for postoperative delirium along with associated short-term complications in geriatric hip fracture patients in a large sample across multiple institutions using the ACS NSQIP database. Here, we demonstrate that age, white race, preoperative ASA classification, baseline dementia, and preoperative delirium were independent risk factors for postoperative delirium. Postoperative delirium was found to be associated with increased perioperative complications and 30-day mortality. Provider foreknowledge of these risks along multidisciplinary management may help prevent the development delirium, improve fracture outcomes, and decrease mortality.

In our study, the incidence of postoperative delirium after hip fracture was 30.4%, within the range of 4% to 65% reported by others.[4-6] This incidence is most consistent with the middling estimate of studies found in a 2007 meta-analysis. Possible explanations for this wide reported range may be attributed to variability in screening tools for delirium, of which at least 5 have been reported including the *Diagnostic and Statistical Manual*, the Mini-Mental Status Examination, and others.[6] Other possibilities include variability in the duration and frequency of testing, not controlling for clinical factors, and the subjective definition of delirium.

Our findings are consistent with several studies that report age and ASA classification as preoperative risk factors for the development of postoperative delirium.[4,9-11,15] In a systematic review of 32 studies, Smith et al found that patients older than 80 were almost twice as likely to develop postoperative delirium after hip surgery.[15] Although no critical age cutoff was defined in this study of geriatric patients, age was found in multivariate regression to predict delirium independent of other comorbidities. In that regard, Mosk et al discovered in 566 patients that ASA class 3 and 4 patients were twice more likely to develop postoperative delirium after hip surgery.[11] We note that in our study, ASA classification, a surrogate for global comorbidity burden, was a predictor of developing postoperative delirium, whereas individual risk factors such as diabetes, CHF, HTN, and others were not. Although our study found that white race was a risk factor for the development of postoperative delirium after a geriatric hip fracture, very few studies have examined race as a contributing risk factor. Brooks Carthon et al found that white geriatric patients undergoing general, orthopedic, or vascular surgery were more likely to develop postoperative delirium.[18] Similarly, when looking at nonsurgical patients in the intensive care unit, Khan et al found that Caucasians ages 18 to 49 were 2.5 times more likely to develop delirium than African Americans; however, no such relationship was found in the geriatric patient population.[19]

Moreover, we found that preoperative dementia and delirium were the strongest independent predictors for the development of postoperative delirium, with a 2- and 10-fold increase in risk, respectively. Neurocognitive deficits may be amplified postoperatively but have not been reported as strong a risk factor to this extent previously.[10,11,20,21] A 2004 study discovered that geriatric patients with a history of dementia were 8 times more likely to develop postoperative dementia after hip fractures.[10] Oh et al also found in a large systemic review that cognitive impairment was one of the strongest preoperative risk factors for postoperative delirium after hip fracture.[21] Other authors have postulated that dementia and delirium are similar processes of brain insult and patients with dementia may have a lower threshold for the development of delirium.[22] Here, preoperative delirium, independent of dementia, was the strongest risk factor for the development of postoperative delirium, which is in agreement with other studies. Mosk et al found that 40% of 196 geriatric patients with postoperative delirium after hip fracture had a prior episode of delirium.[11] Litaker et al also reported that in a cohort of 500 patients undergoing elective surgery, with more than half orthopedic related, a history of prior delirium was associated with a 4-fold greater risk of developing postoperative delirium.[23]

In contrast to other studies, sex and BMI were not independent risk factors for postoperative delirium in this investigation.[10,24,25] Edelstein et al reported that males were twice as likely to develop postoperative delirium after geriatric hip fractures.[10] However, it is important to note that the incidence of postoperative delirium in the study was 5.1%, which is comparably much lower than other published studies. The low incidence, as cited by the authors, may be secondary to the strict inclusion criteria used in the study that selects for healthier individuals. Furthermore, in contrast with our findings, Juliebø et al found in a cohort of 237 elderly patients with hip fracture that a BMI <20 increased the odds of postoperative delirium by nearly 3-fold.[26] We suspect this discrepancy in regard to sex and BMI as risk factors for postoperative delirium may be primarily attributed to smaller sample sizes and confounding variables such as healthier patient populations.

Geriatric hip fractures complicated by postoperative delirium were found to have a significantly higher risk-adjusted 30-day mortality, which is comparable to multiple studies that have examined mortality rates at 6 months and 1 year or more.[8,10,11,27] In our study, patients with postoperative delirium had a 7.2% increase in 30-day mortality. Bellelli et al, after adjusting for covariates, found that each day of postoperative delirium after hip fracture surgery increased the hazard of dying within 6 months by 17%.[8] They concluded that the duration of postoperative delirium is an important prognostic factor in mortality. Lundström et al also found that 72.4% (21/29) of geriatric patients with postoperative delirium after hip fracture surgery died within 5 years, compared with 34.7% (17/49) of those who did not have delirium.[27] Although data on long-term mortality following hip fractures are well studied, data on short-term mortality risk are less well studied and are a fundamental point derived from this study for providers to be aware of.

Besides mortality, our study found that postoperative delirium after geriatric hip fractures correlated with increased rates of several perioperative complications including pneumonia, UTI, CVA, MI, and sepsis. Postoperative delirium was also independently associated with increased LOS, hospital readmission within 30 days, and discharge to and stay in inpatient facilities. Our findings are agreeable with multiple prior studies showing these differences individually.[9,20,28,29] Mosk et al discovered that postoperative delirious hip fracture patients had higher rates of pneumonia, UTI, CVA, pulmonary complications, institutionalization, and LOS.[11] It is important to note, as other authors have also acknowledged, that these postoperative complications may have caused the delirious episode and it is difficult to ascertain which came first—the episode of delirium or the associated postoperative complication. Marcantonio et al also found that in 126 geriatric hip fracture patients, those with postoperative delirium were 3 times more likely to be placed in a new nursing home than those without at 1-month follow-up.[30] These differences in hospital readmissions and inpatient facility utilization rates are important drivers both of patient outcome and cost worthy of further study. For instance, Medicare payments for unplanned readmissions account for more than US$17 billion spent annually.[31] For hip fracture in particular, one study reported that each readmission costs an average of US$14 000.[32] Furthermore, discharge to inpatient facilities is associated with more adverse events and costs as high as 25.4% of total episode-of-care payments after hip surgery.[33,34]

Patients with postoperative delirium were also much less likely to comply with the WBAT immediately postoperatively. Marcantonio et al similarly found that after adjusting for age

and medical comorbidities, patients with postoperative delirium were more likely to have a decline in ambulation.[30] It is difficult to determine whether delirium may contribute to the decline in postoperative ambulation or whether the delay in ambulation may contribute to the development of delirium. For example, Kamel et al discovered that time to ambulation after hip surgery was an independent predictor of the development of new-onset delirium.[35] Regardless, the benefits of early ambulation after hip fracture surgery have been well studied and are an important outcome measure in perioperative hip fracture care.[36-38]

Acute hospitalization is responsible for 57% of total costs in caring for a hip fracture; thus, hospital polices and strategies to mitigate the risk of developing delirium and sequelae remain a priority.[39] Inouye et al found that 30% to 40% of the delirium during geriatric hospitalizations could be prevented by treatment of the risk factors.[16] There are several studies that showed comprehensive geriatric care (CGC), comprehensive geriatric assessment (CGA), and adoption of delirium prevention protocols may reduce the development of delirium during acute hospitalizations.[40-43] The CGC includes comanaged care between geriatricians, orthopedic surgeons, and interdisciplinary teams.[44] The CGA is used to determine the medical, psychological, and functional capabilities of elderly patients in order to develop an integrated plan for treatment and prevention of delirium.[42,45] Lundström et al found that in 199 geriatric hip fracture patients, CGA intervention reduced both the number of postoperative complications and length of total hospitalization by 10 days compared to those without intervention.[27] Thus, provider foreknowledge of delirium risk factors outlined in this study may help multidisciplinary teams develop integrated plans and policies for the prevention of delirium and reduce costs to patients, Medicare, and hospital systems going forward.

There are several notable advantages to such a study design, including data from a large sample size that are derived from multiple institutions, anonymized, less susceptible to publication bias, and reliable in quality. However, such a study design also has several limitations that merit discussion. Firstly, patient outcomes and complication data in the ACS NSQIP series are limited to 30 days postoperatively; thus, the duration of delirium and associated mortality rates beyond this time frame could not obtained. This may be an important consideration as the duration of postoperative delirium may be an important long-term prognostic factor in mortality.[8] Secondly, ACS NSQIP only collects reports on specific perioperative data and complications. Although the data are reliable and closely audited, some relevant preoperative patient data are not available in the ACS NSQIP. Data on possible preoperative risk factors for delirium such as use of physical restraints, polypharmacy, general anesthesia, or preoperative indwelling urinary catheter were not available. Finally, because there are no objective criteria to define delirium, individual centers reporting to NSQIP may present concerns for internal and external validity. This is intrinsic to the body of literature on delirium in geriatric hip fractures as a whole and is reflected by differences in the incidence of postoperative delirium reported between studies.[6]

Conclusion

In conclusion, postoperative delirium is a common occurrence in geriatric hip fractures that may be preventable. Risk factors are increased age, ASA classification, white race, and history of dementia or delirium. Postoperative delirium was associated with increase in medical complications, LOS, readmissions, discharge and stay in inpatient facility, and 30-day mortality. Ultimately, provider foreknowledge of such risks and complications along with multidisciplinary management efforts may allow development of integrated plans for the prevention of postoperative delirium and sequelae in geriatric hip fractures.

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