Hindawi Publishing Corporation
Advances in Orthopedic Surgery
Volume 2016, Article ID 4913808, 10 pages
http://dx.doi.org/10.1155/2016/4913808

Hindawi

Research Article

The Influence of Psychiatric Comorbidity on Inpatient Outcomes following Distal Humerus Fractures

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Received 2 December 2015; Revised 28 March 2016; Accepted 29 March 2016

Academic Editor: Werner Kolb

Background. The influence of psychiatric comorbidity on outcomes following inpatient management of upper extremity fractures is poorly understood. *Methods*. The National Hospital Discharge Survey was queried to identify patients admitted to US hospitals with distal humerus fractures between 1990 and 2007. Patients were subdivided into 5 groups: depression, anxiety, schizophrenia, dementia, and no psychiatric comorbidity. Multivariable logistic regression analysis identified independent risk factors for adverse events, requirement of blood transfusion, and discharge to another inpatient facility. *Results*. A cohort representative of 526,185 patients was identified as having a distal humerus fracture. Depression, anxiety, and dementia were independently associated with higher odds of in-hospital adverse events ($P < 0.001$). Depression was associated with higher odds of inpatient blood transfusion ($P < 0.001$). Depression, schizophrenia, and dementia were associated with higher odds of nonroutine discharge to another inpatient facility ($P < 0.001$). Patients with a diagnosis of schizophrenia had a mean of 12 ($P < 0.001$) more days of care than patients with no psychiatric comorbidity. *Discussion*. Patients with comorbid psychiatric illness who are admitted to hospitals with distal humerus fractures are at increased risk of inpatient adverse events and posthospitalization care.

1. Introduction

Psychiatric comorbidity is associated with longer hospital stays, higher risk of suboptimal outcomes, and increased resource utilization among patients undergoing inpatient surgery [1–7]. Major depressive disorder and anxiety are the most common psychiatric diagnoses [1–5]. Schizophrenia is less common, with an estimated prevalence of one percent [8], but is associated with significant cognitive impairment [9]. Dementia is present in approximately six percent of the population over 60 years of age [6]. The rate of elderly individuals with psychiatric disorders is projected to double by 2030 [10].

In orthopaedics, psychiatric comorbidity has been associated with worse long-term outcomes (i.e., pain and disability) following total knee arthroplasty [11], major spine surgery [12], and orthopaedic trauma [13]. Psychiatric comorbidity with concurrent antipsychotic and antidepressant use are known risk factors for extremity fractures [14–16], postulated to be a result of decreased bone mineral density. While prior research in lower extremity fractures has demonstrated longer hospital stays, more in-hospital adverse events, and lower rates of discharge to home among patients with psychiatric comorbidity [17], there is a paucity of data on the influence of psychiatric illness on acute, inpatient outcomes among patients admitted with upper extremity fractures. This study sought to evaluate the influence of psychiatric illness on length of stay, mortality, in-hospital adverse events, requirement for blood transfusion, and nonroutine discharge to another inpatient facility among patients admitted with distal humerus fractures. Knowledge of the effects of psychiatric illness on inpatient outcomes may be used for planning and resource allocation for orthopaedic patients with psychiatric illness.

2. Materials and Methods

2.1. Data Source. The National Hospital Discharge Survey (NHDS) database, developed by the National Center for Health Statistics [18], was used to evaluate the influence of psychiatric comorbidity on outcomes following distal humerus fractures. The NHDS is a publically available survey providing demographic and medical data for inpatients discharged from nonfederal, short-stay hospitals in the United States [19]. It is the principal database used by the US government for monitoring hospital use and is thought to be the most comprehensive of all inpatient surgical databases in use [19]. The survey, which began in 1965 and has been collected annually since then, uses International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes [20] for classifying medical diagnoses and procedures. Using a stratified, multistage probability design, the NHDS collects demographic information (age, gender, and race), expected source of payment (insurance status), medical information of up to seven discharge diagnoses and up to four procedures, length of care, hospital size, US region, and inpatient outcomes including discharge destination [21]. The NHDS uses a complex three-stage probability design to ensure an unbiased national sampling of inpatient records including inflation by reciprocals of the probabilities of sample selection and adjustment for no response and population weighting ratio adjustments [19]. Because the NHDS is a publically available database with no patient identifying information, this study did not require approval by the institutional review board.

2.2. Study Population. Using ICD-9-CM codes, we identified all patients admitted in the United States with a distal humerus fracture between 1990 and 2007. Discharges with a diagnosis code (ICD-9-CM) of closed fracture of lower end of humerus (812.4x) or open fracture of lower end of humerus (812.5x) were identified using previously described techniques [22]. Patients managed surgically with open reduction and internal fixation (ORIF) or closed reduction and internal fixation (CRIF) were identified using ICD-9 procedure codes 79.3x and 79.1x, respectively. To analyze their influence on inpatient outcomes, psychiatric comorbidities were divided into four groups: depression (ICD-9-CM 296.2, 296.3, 296.5, 296.9, 300.4, 301.12, 309.0, and 311.x), anxiety (ICD-9-CM 300.0x, 309.24, and 309.28), schizophrenia (ICD-9-CM 295.x), and dementia (ICD-9-CM 290.x). After obtaining our study population, demographic variables were collected including age, sex, primary diagnosis, type of fracture, prevalence of comorbidities, length of stay, and discharge destination. The complication screening package [23] was used to determine the incidence of complications and the variable of adverse event was created based on the variables: shock (998.0), bleeding (998.1), acute postoperative infection (998.5), acute postoperative anemia (285.1), acute renal failure (584), acute myocardial infarction (410), pulmonary embolism (415.1), induced mental disorder (293), pneumonia (480–486), pulmonary insufficiency (518.5), deep venous thrombosis (453.4), intubation (96.xx), and transfusion of blood (99.x).

2.3. Statistics. We assumed a normal distribution of the data because of the large sample size. Differences between categorical variables were compared using the Pearson chi-square test and the independent-samples t-tests were used to compare differences between continuous variables. To analyze whether depression, anxiety, schizophrenia, or dementia were independent predictors of a negative in-hospital outcome (adverse events, requirement for blood transfusion, or discharge to inpatient facility), all variables present in at least 2% of the population [24] were included in a multivariable binary logistic regression model; for in-hospital adverse events, a 1% cutoff was used due to their lower rates of occurrence, as previously described [25]. The dichotomous variables were (1) presence of adverse events, (2) need for blood transfusion, and (3) discharge to inpatient facility. The multivariable regression model allowed us to control for potential confounders and isolate the effect of psychiatric illness on inpatient outcomes. Notably, the cooccurrence of psychiatric comorbidity was rare with depression and anxiety in 33 patients (0.00%), depression and schizophrenia in 46 patients (0.01%), and no cooccurrence of other psychiatric comorbidities. Covariates accounted for in the regression model included gender, age, region of the country, and preexisting comorbidities (anemia, obesity, diabetes mellitus, hypertension, congestive heart failure, coronary artery disease, atrial fibrillation, prior myocardial infarction, osteoporosis, connective tissue disease, thyroid disease, and chronic obstructive pulmonary disease). Odds ratios and confidence intervals were calculated to assess the association between psychiatric comorbidities and inpatient outcomes. To correct for multiple comparisons, a P value of <0.001 was used to define statistical significance, as previously described [25]. All data were analyzed using the statistical package for social sciences [SPSS] software version 20 (Chicago, IL, USA).

3. Results

A cohort representative of 526,185 discharges with a diagnosis of distal humerus fracture, between 1990 and 2007, was retrieved from the NHDS database. The prevalence of depression was 1.27%, anxiety was 0.42%, schizophrenia was 0.2%, and dementia was 0.36%. The mean age of the cohort was 30.3 years (95% CI, 27.6 to 33.0 years) while those with psychiatric illness were significantly older ($P < 0.001$) (Table 1). Females comprised 50.2% of the total cohort, 67.5% of patients with depression and greater than 80% of patients with either dementia or anxiety (Table 1). The most common diagnosis was closed supracondylar humerus fracture (ICD-9-CM 812.41), followed by closed fracture of unspecified part of humerus (812.4), and closed fracture of lateral condyle of humerus (812.42). Length of hospital stay was significantly longer for patients with schizophrenia (16.12 days) compared with nonpsychiatric patients (3.96; $P < 0.001$) (Table 1). In-hospital mortality was lower in patients with depression ($P < 0.001$), but not statistically significantly different between patients with anxiety, dementia, or schizophrenia and no psychiatric comorbidity (Table 1).

The prevalence of comorbidities and adverse events with bivariate analyses are listed in Tables 2 and 3, respectively.

Table 1: Patient characteristics for patients with distal humerus fractures with bivariate analysis comparing those with a concomitant diagnosis of depression, anxiety, dementia, and schizophrenia to those not affected by any psychiatric diagnosis (SEM, standard error of mean).

Parameter	Total, percentage (%)	Psychiatric comorbidity								
		None, %	Depression, %	*P*	Anxiety, %	*P*	Schizophrenia, %	*P*	Dementia, %	*P*
N =	526,185	514,432	6,700		2,191		1,067		1,874	
% of total cohort	100.0%	97.8%	1.3%		0.4%		0.2%		0.4%	
Gender										
Male	49.8%	50.2%	32.5%	<0.001	13.6%	<0.001	73.1%	<0.001	19.8%	<0.001
Female	50.2%	49.8%	67.5%		86.4%		26.9%		80.2%	
Age										
<8	35.2%	36.0%	0.0%	<0.001	1.7%	<0.001	0.0%	<0.001	0.0%	<0.001
8–25	22.2%	22.5%	7.9%		16.0%		21.8%		0.0%	
26–50	14.6%	14.4%	14.9%		36.5%		74.0%		0.0%	
>50	28.0%	27.1%	77.2%		45.8%		4.2%		100.0%	
Primary diagnosis										
812.4 (fracture of lower end of humerus closed)	19.0%	18.6%	29.7%	<0.001	14.9%	<0.001	19.3%	0.577	75.9%	<0.001
812.41 (closed supracondylar fracture of humerus)	48.2%	48.7%	24.9%	<0.001	34.6%	<0.001	56.2%	<0.001	14.2%	<0.001
812.42 (closed fracture of lateral condyle of humerus)	9.5%	9.7%	1.6%	<0.001	4.4%	<0.001	5.0%	<0.001	0.0%	<0.001
812.43 (closed fracture of medial condyle of humerus)	5.3%	5.1%	16.9%	<0.001	31.8%	<0.001	0.0%	<0.001	0.0%	<0.001
812.44 (closed fracture of unspecified condyle(s) of humerus)	4.7%	4.8%	4.0%	0.002	0.0%	<0.001	6.1%	0.041	7.5%	<0.001
812.49 (other closed fractures of lower end of humerus)	4.0%	3.9%	16.0%	<0.001	7.8%	<0.001	5.4%	0.007	2.4%	0.001
812.5 (fracture of lower end of humerus open)	3.1%	3.2%	2.8%	0.109	0.0%	<0.001	8.0%	<0.001	0.0%	<0.001
812.51 (open supracondylar fracture of humerus)	3.9%	4.0%	0.0%	<0.001	0.0%	<0.001	0.0%	<0.001	0.0%	<0.001
812.52 (open fracture of lateral condyle of humerus)	0.9%	0.9%	0.9%	0.902	0.0%	<0.001	0.0%	0.002	0.0%	<0.001
812.53 (open fracture of medial condyle of humerus)	1.2%	1.2%	4.1%	<0.001	0.0%	<0.001	0.0%	<0.001	0.0%	<0.001
812.54 (open fracture of unspecified condyle(s) of humerus)	0.6%	0.6%	0.0%	<0.001	4.0%	<0.001	0.0%	0.009	0.0%	<0.001
812.59 (other open fractures of lower end of humerus)	1.2%	1.2%	1.0%	0.198	4.6%	<0.001	0.0%	<0.001	0.0%	<0.001
Comorbidities										
No	84.9%	85.5%	47.5%	<0.001	65.5%	<0.001	96.4%	<0.001	50.9%	<0.001
Yes	15.1%	14.5%	52.5%		34.5%		3.6%		49.1%	
Adverse events										
No	93.8%	94.1%	76.7%	<0.001	92.8%	0.013	100.0%	<0.001	75.2%	<0.001
Yes	6.2%	6.0%	23.3%		7.2%		0.0%		24.8%	

Table 1: Continued.

Parameter	Total, percentage (%)	Psychiatric comorbidity								
		None, %	Depression, %	*P*	Anxiety, %	*P*	Schizophrenia, %	*P*	Dementia, %	*P*
Discharge disposition										
Routine/home (1)	85.0%	85.7%	50.8%		97.8%		37.2%		25.2%	
Left AMA (2)	0.3%	0.2%	1.8%		0.0%		0.0%		0.0%	
Short-term fac (3)	2.8%	2.6%	19.6%		0.0%		4.0%		0.0%	
Long-term fac (4)	7.3%	6.9%	19.4%	<0.001	0.0%	<0.001	40.6%	<0.001	69.3%	<0.001
Alive, not stated (5)	3.2%	3.1%	5.6%		2.2%		18.2%		3.0%	
Dead (6)	0.2%	0.2%	0.0%		0.0%		0.0%		0.0%	
Not reported (9)	1.3%	1.3%	3.0%		0.0%		0.0%		2.4%	
Mortality	0.2%	0.2%	0.0%	<0.001	0.0%	0.036	0.0%	0.144	0.0%	0.053
Age (years), mean (SE)	30.3 (1.37)	29.54 (1.33)	65.16 (2.94)	<0.001	52.42 (2.36)	<0.001	38.04 (1.72)	<0.001	84.7 (3.82)	<0.001
Days of care, mean (SE)	3.98 (0.18)	3.96 (0.18)	4.11 (0.19)	0.924	2.49 (0.11)	0.595	16.12 (0.73)	<0.001	3.8 (0.17)	0.957

Table 2: Prevalence of comorbidities and bivariate analysis in patients with distal humerus fractures comparing those with a concomitant diagnosis of depression, anxiety, dementia, or schizophrenia to those with none of these diagnoses.

Parameter (ICD-9)	Total (N = 526,185)	Psychiatric comorbidity								
	Percentage (%)	None, %	Depression, %	P	Anxiety, %	P	Schizophrenia, %	P	Dementia, %	P
Thyroid disease (240–246)										
No	97.86%	97.90%	94.49%	<0.001	98.17%	<0.001	100.00%	<0.001	96.10%	<0.001
Present	2.14%	2.10%	5.51%		1.83%		0.00%		3.90%	
Diabetes mellitus (250)										
No	95.25%	95.29%	91.58%	<0.001	95.85%	0.22	100.00%	<0.001	94.88%	0.4
Present	4.75%	4.71%	8.42%		4.15%		0.00%		5.12%	
Obesity (278.00, 278.01)										
No	99.66%	99.66%	99.36%	<0.001	100.00%	0.006	100.00%	0.056	100.00%	0.011
Present	0.34%	0.34%	0.64%		0.00%		0.00%		0.00%	
Hypertensive disease (401–405)										
No	90.72%	90.94%	74.61%	<0.001	95.85%	<0.001	96.44%	<0.001	78.44%	<0.001
Present	9.28%	9.06%	25.39%		4.15%		3.56%		21.56%	
Old myocardial infarction (412)										
No	99.48%	99.52%	96.04%	<0.001	100.00%	0.001	100.00%	0.023	100.00%	0.003
Present	0.52%	0.48%	3.96%		0.00%		0.00%		0.00%	
Coronary artery disease (414.01)										
No	99.03%	99.14%	91.51%	<0.001	100.00%	<0.001	100.00%	0.002	94.40%	<0.001
Present	0.97%	0.86%	8.49%		0.00%		0.00%		5.60%	
Atrial fibrillation (427.31)										
No	98.04%	98.14%	90.58%	<0.001	100.00%	<0.001	100.00%	<0.001	94.29%	<0.001
Present	1.96%	1.86%	9.42%		0.00%		0.00%		5.71%	
Congestive heart failure (428)										
No	98.17%	98.21%	97.69%	0.001	100.00%	<0.001	100.00%	<0.001	85.06%	<0.001
Present	1.83%	1.79%	2.31%		0.00%		0.00%		14.94%	
Chronic pulmonary disease (490–496)										
No	99.93%	99.93%	99.58%	<0.001	100.00%	0.215	100.00%	0.387	100.00%	0.252
Present	0.07%	0.07%	0.42%		0.00%		0.00%		0.00%	
Connective tissue disease (710)										
No	99.93%	99.93%	100.00%	0.03	100.00%	0.215	100.00%	0.387	100.00%	0.252
Present	0.07%	0.07%	0.00%		0.00%		0.00%		0.00%	
Osteoporosis (733.0)										
No	98.46%	98.70%	90.51%	<0.001	71.52%	<0.001	100.00%	<0.001	89.49%	<0.001
Present	1.54%	1.30%	9.49%		28.48%		0.00%		10.51%	

Table 3: Prevalence of adverse events in patients with distal humerus fractures with bivariate analysis comparing those with a concomitant diagnosis of depression, anxiety, dementia, or schizophrenia to those with none of these diagnoses.

Parameter (ICD-9)	Total (N = 526,185)	Psychiatric comorbidity								
	Percentage	None, %	Depression, %	P	Anxiety, %	P	Schizophrenia, %	P	Dementia, %	P
Postoperative bleeding (998.1)										
No	99.76%	99.76%	100.00%	<0.001	100.00%	0.021	100.00%	0.109	100.00%	0.034
Present	0.24%	0.24%	0.00%		0.00%		0.00%		0.00%	
Acute postoperative infection (998.5)										
No	99.56%	99.55%	100.00%	<0.001	100.00%	<0.001	100.00%	0.028	100.00%	0.004
Present	0.44%	0.45%	0.00%		0.00%		0.00%		0.00%	
Acute postoperative anemia (285.1)										
No	97.90%	97.93%	96.27%	<0.001	84.84%	<0.001	100.00%	<0.001	100.00%	<0.001
Present	2.10%	2.07%	3.73%		5.16%		0.00%		0.00%	
Acute renal failure (584)										
No	99.79%	99.79%	99.34%	<0.001	100.00%	0.032	100.00%	0.134	100.00%	0.047
Present	0.21%	0.21%	0.66%		0.00%		0.00%		0.00%	
Acute myocardial infarction (410)										
No	99.82%	99.81%	100.00%	<0.001	100.00%	0.041	100.00%	0.154	99.25%	<0.001
Present	0.18%	0.19%	0.00%		0.00%		0.00%		0.75%	
Pulmonary embolism (415.1)										
No	99.89%	99.89%	100.00%	0.007	100.00%	0.12	100.00%	0.278	100.00%	0.151
Present	0.11%	0.11%	0.00%		0.00%		0.00%		0.00%	
Induced mental disorder (293)										
No	99.70%	99.70%	100.00%	<0.001	100.00%	0.01	100.00%	0.073	100.00%	0.018
Present	0.30%	0.30%	0.00%		0.00%		0.00%		0.00%	
Pneumonia (480–486)										
No	99.11%	99.33%	89.01%	<0.001	97.95%	<0.001	100.00%	0.007	76.57%	<0.001
Present	0.89%	0.67%	10.99%		2.05%		0.00%		23.43%	
Pulmonary insufficiency (518.5)										
No	99.74%	99.73%	100.00%	<0.001	100.00%	0.015	100.00%	0.089	100.00%	0.024
Present	0.26%	0.27%	0.00%		0.00%		0.00%		0.00%	
Deep venous thrombosis (453.4)										
No	99.99%	99.99%	100.00%	0.415	100.00%	0.641	100.00%	0.745	100.00%	0.666
Present	0.01%	0.01%	0.00%		0.00%		0.00%		0.00%	
Intubation (96.x)										
No	98.80%	98.80%	98.84%	0.789	97.95%	<0.001	100.00%	<0.001	100.00%	<0.001
Present	1.20%	1.20%	1.16%		2.05%		0.00%		0.00%	
Transfusion of blood (99.0)										
No	98.60%	98.66%	93.27%	<0.001	98.81%	0.533	100.00%	<0.001	99.36%	0.008
Present	1.40%	1.34%	6.73%		1.19%		0.00%		0.64%	

Table 4: Logistic regression for predictors of adverse events among patients hospitalized for distal humerus fracture (N = 526,185). CI, confidence interval; OR, odds ratio.

Variable	OR (95% CI)	P
Dementia	5.024 (4.522–5.583)	<0.001
Congestive heart failure	4.881 (4.660–5.113)	<0.001
Depression	4.742 (4.476–5.024)	<0.001
Atrial fibrillation	3.493 (3.323–3.673)	<0.001
Osteoporosis	3.111 (2.931–3.301)	<0.001
Coronary artery disease	3.055 (2.876–3.245)	<0.001
Diabetes mellitus	2.679 (2.580–2.781)	<0.001
History of myocardial infarction	2.264 (2.058–2.491)	<0.001
Hypertension	1.667 (1.614–1.773)	<0.001
Open reduction and internal fixation	1.499 (1.466–1.533)	<0.001
DOC	1.041 (1.040–1.043)	<0.001
Age	1.016 (1.016–1.017)	<0.001
Obesity	1.166 (1.009–1.348)	0.0373
Region	1.013 (1.002–1.024)	0.017
Connective tissue disease	1.357 (0.982–1.875)	0.0648
Anxiety	1.171 (0.995–1.377)	0.0571
Sex (M)	0.781 (0.762–0.800)	<0.001
Thyroid disease	0.578 (0.524–0.637)	<0.001
Closed reduction and internal fixation	0.115 (0.110–0.121)	<0.001
Schizophrenia	0.007 (0.004–0.113)	0.001

Omnibus $\chi^2 = 4746$, $P < 0.001$.
Nagelkerke $R^2 = 0.0663$.

Table 5: Logistic regression for predictors of requirement for blood transfusion among patients with distal humerus fractures (N = 526,185). CI, confidence interval; OR, odds ratio.

Variable	OR (95% CI)	P
Postop anemia	14.145 (13.325–15.015)	<0.001
Osteoporosis	7.032 (6.479–7.632)	<0.001
Depression	5.334 (4.834–5.886)	<0.001
Diabetes mellitus	5.179 (4.887–5.488)	<0.001
Atrial fibrillation	3.966 (3.637–4.325)	<0.001
Congestive heart failure	3.913 (3.607–4.244)	<0.001
Hypertension	3.427 (3.263–3.598)	<0.001
Postoperative bleeding	2.928 (2.204–3.888)	<0.001
Open reduction internal fixation	2.750 (2.618–2.888)	<0.001
Sex (M)	2.216 (2.080–2.361)	<0.001
Coronary artery disease	2.091 (1.924–2.271)	<0.001
History of myocardial infarction	1.670 (1.319–2.116)	<0.001
Thyroid disease	1.466 (1.283–1.675)	<0.001
Age	1.041 (1.040–1.042)	<0.001
Region	0.960 (0.937–0.982)	0.001
Anxiety	0.843 (0.572–1.242)	0.3875
Obesity	0.639 (0.390–1.045)	0.0743
Closed reduction internal fixation	0.146 (0.133–0.161)	<0.0001
Pulmonary embolism	0.062 (0.004–0.997)	0.0497
Schizophrenia	0.033 (0.002–0.525)	0.0157

Omnibus $\chi^2 = 4746$, $P < 0.001$.
Nagelkerke $R^2 = 0.2062$.

Hypertensive disease was the most common comorbidity at 9.28% followed by diabetes mellitus at 4.75%. Psychiatric comorbidity was associated with a higher rate of inpatient adverse events (depression, 23.27%, anxiety, 7.21%, and dementia, 24.81%) compared with no psychiatric comorbidity (6.23%) (Tables 1 and 3). For patients with depression and dementia, the most common adverse event was pneumonia at 10.99% and 23.43%, respectively. Multivariable logistic regression analysis showed dementia (OR 5.024, range: 4.522 to 5.583, $P < 0.001$), depression (OR 4.742, range: 4.476 to 5.024, $P < 0.001$), and those treated with ORIF (OR 1.499, range: 1.466 to 1.533, $P < 0.001$) to be independently associated with higher odds of inpatient adverse events, whereas there was a lower odds ratio of adverse event among those treated with CRIF (OR 0.115, range: 0.110 to 0.121, $P < 0.001$) (model fit: for omnibus test of model coefficients: $\chi^2 = 4746$, $P < 0.001$, Nagelkerke $R^2 = 0.0663$; Table 4).

Among the total cohort, 2.1% of patients experienced acute postoperative anemia. In multivariable logistic regression analysis, patients with depression (OR 5.334, range: 4.834 to 5.886, $P < 0.001$) and those treated with ORIF (OR 2.75, range: 2.618 to 2.884, $P < 0.001$) had significantly higher odds of blood transfusion, while patients with schizophrenia (OR 0.033, range: 0.002 to 0.525, $P < 0.001$), dementia (OR 0.452, range: 0.256 to 0.797, $P = 0.006$), and those treated with CRIF (OR 0.146, range: 0.133 to 0.161, $P < 0.001$) had a lower odds ratio of requiring blood transfusion (model fit: omnibus test of model coefficients: $\chi^2 = 4746$, $P < 0.001$, Nagelkerke $R^2 = 0.2062$; Table 5).

Patients with comorbid mental illness experienced a higher rate of discharge to inpatient short- or long-term facility (depression, 38.9%, schizophrenia, 44.6%, and dementia, 69.3%) compared with patients who had no psychiatric comorbidity (9.5%). In multivariable regression analysis, dementia (OR 20.609, range: 18.674 to 22.745, $P < 0.001$), schizophrenia (OR 7.232, range: 6.708 to 8.163, $P < 0.001$), and depression (OR 5.909, range: 5.621 to 6.212, $P < 0.001$) were independently associated with nonroutine discharge to another inpatient facility, while patients treated surgically with ORIF (OR 0.785, range: 0.771 to 0.800, $P < 0.001$) or CRIF (OR 0.197, range: 0.190 to 0.203, $P < 0.001$) had a lower odds ratio of nonroutine discharge (model fit: omnibus test of model coefficients: $\chi^2 = 4717$, $P < 0.001$, Nagelkerke $R^2 = 0.482$; Table 6).

4. Discussion

Psychiatric comorbidity is a common cause of disability, a known contributor to poor quality of life and increased healthcare resource utilization [25–27]. Previously, groups

Table 6: Logistic regression for predictors of requirement for discharge to another inpatient facility among patients with distal humerus fractures (N = 526,185). CI, confidence interval; OR, odds ratio.

Variable	OR (95% CI)	P
Dementia	20.609 (18.674–22.745)	<0.001
Congestive heart failure	8.376 (8.081–8.682)	<0.001
Atrial fibrillation	7.330 (7.075–7.594)	<0.001
Schizophrenia	7.232 (6.408–8.163)	<0.001
Depression	5.909 (5.621–6.212)	<0.001
Diabetes mellitus	5.598 (5.446–5.754)	<0.001
Hypertension	5.419 (5.305–5.535)	<0.001
Transfusion	5.157 (4.939–5.386)	<0.001
Coronary artery disease	4.917 (4.682–5.164)	<0.001
Osteoporosis	4.704 (4.489–4.930)	<0.001
Thyroid disease	4.280 (4.108–4.458)	<0.001
History of myocardial infarction	3.974 (3.686–4.286)	<0.001
Chronic pulmonary disease	1.985 (1.534–2.567)	<0.001
Obesity	1.617 (1.420–1.840)	<0.001
Sex (M)	1.356 (1.319–1.394)	<0.001
Region	1.153 (1.139–1.167)	<0.001
DOC	1.059 (1.058–1.060)	<0.001
Thyroid disease	1.053 (1.052–1.054)	<0.001
Open reduction and internal fixation	0.785 (0.771–0.800)	<0.001
Closed reduction and internal fixation	0.197 (0.190–0.203)	<0.001
Anxiety	0.002 (0.000–0.032)	<0.001

Omnibus $\chi^2 = 4717$, $P < 0.001$.
Nagelkerke $R^2 = 0.4820$.

have demonstrated poor long-term outcomes after orthopaedic surgery for patients with psychiatric illness [26]. However, reports are conflicting on whether psychiatric comorbidities affect inpatient outcomes in patients with musculoskeletal injuries, as some studies have demonstrated decreased rates of major in-hospital complications and mortality [22]. The influence of psychiatric comorbidities on lower extremity fractures has previously been investigated [17]. In this study, we used nationally representative data collected over a 17-year period to evaluate the effect of psychiatric comorbidity on inpatient adverse events, requirement for blood transfusion, and discharge status for patients admitted with distal humerus fractures.

The findings of this study demonstrate that, in patients admitted with distal humerus fractures, diagnoses of depression and dementia are associated with higher odds of in-hospital adverse events. This finding is consistent with previous studies conducted by Hu et al. [28], Bot et al. [25], and Beresnevait et al. [7] who found increased complication rates among patients with psychiatric illness who are undergoing surgery. Of note, our study demonstrated a decreased risk of adverse events for patients with schizophrenia, which is contradictory to previous findings [17]. One reason for this discrepancy could be the small sample size of only 1,007 patients. Another reason could be due to the limited coding available in the database. The NHDS only allows for 7 diagnosis codes per weighted case, which may limit the amount of comorbidities and adverse events listed.

This study found depression to be associated with increased odds of requirement for blood transfusion in patients with distal humerus fractures. A possible explanation for this finding is that medications used for the treatment of depression, such as selective serotonin reuptake inhibitors, inhibit platelet activity and could result in increased bleeding [29, 30]. It is also possible that symptoms of depression, such as fatigue, may mimic symptoms of anemia leading to a higher rate of transfusion. Paradoxically, patients with anxiety had increased rates of postoperative anemia but lower rates of blood transfusion. In our study, patients with anxiety had the shortest hospital stay at 2.49 days, which may have limited their treatment options and could explain their decreased rate of transfusion despite increased rates of anemia.

This study demonstrated an increased risk for nonroutine discharge to another inpatient facility for patients with depression, schizophrenia, and dementia after hospitalization with a distal humerus fracture. In addition, in-hospital days of care were significantly greater for patients with depression and schizophrenia. These findings correlate with prior studies showing psychiatric illnesses, in patients with orthopaedic conditions, are independent risk factors for increased health-care resource utilization [25–27].

Interestingly, mortality rates were lower among patients with depression. This finding is in line with studies by previous groups and has been postulated to be due to increased attention from health care professionals due to heightened fear and awareness of pain and symptoms by these patients [31]. While the mechanism of fracture is unknown due to limitations of the database, our results demonstrate that patients with no comorbid psychiatric diagnoses were significantly younger. It is possible this cohort sustained a distal humerus fracture from a high-energy mechanism, possibly as part of a polytrauma, which may explain the higher morbidity.

The use of the NHDS database for this study allowed for a national analysis of a large number of patients over a 17-year period. However, despite the benefits of using a large, national database [32], this type of data collection poses several limitations [33]. Diagnosis codes and procedure codes were collected to compose all parts of the statistical analysis. Misclassification of ICD-9-CM codes poses an intrinsic source of error. However, misclassifications are likely distributed evenly among groups, preventing them from affecting our statistical analysis [34]. Additionally, the database only allows for seven diagnosis codes and four procedure codes per entry. As a result, the prevalence of comorbid conditions and adverse events may be underreported, as the prevalences found in this study are lower than other national estimates of depression, anxiety, and dementia [35–37]. This is similar to multiple prior administrative database studies [17, 25]. Another potential cause of the lower prevalence may be that patients with distal humerus fractures who

have psychiatric comorbidities may not be admitted to the hospital and are selected to receive conservative treatment from initial presentation. It is also possible that the lower numbers among patients with distal humerus fractures and psychiatric comorbidities may be due to inequities in access to care, or they may be neglected and not present to the hospital or they may choose not to receive treatment at all. Regardless of the cause, because all cases undergo the same data collection process, potential underreporting should be equally distributed. Another limitation is that the database only provides inpatient data, so complications that arise after discharge are not obtainable. What is more, the large sample size may have resulted in the identification of statistically significant differences that may not be clinically relevant. Additionally, calculation of odds ratios by binomial logistic regression has been shown to result in an overestimate of effect when the outcome occurs in greater than 10 percent of the cohort [38] and thus should be interpreted as a trend instead of an absolute effect size. Finally, the influence of treatment status among patients with psychiatric illness is unknown, as medications are not listed in the database. Therefore, it is impossible to discern whether treatment of psychiatric illness influences outcomes in patients admitted with distal humerus fractures.

5. Conclusion

In conclusion, this study utilized the NHDS to analyze US national data over a 17-year period and showed that psychiatric illness poses an increased risk of in-hospital adverse events, requirement for blood transfusion, and nonroutine discharge to an inpatient facility for patients admitted with distal humerus fractures. These findings may aid healthcare providers in appropriately allocating resources to orthopaedic patients with psychiatric illness.

Ethical Approval

This study was conducted using the National Hospital Discharge Survey, a publically available database conducted by the Centers for Disease Control and Prevention, in which all data are deidentified and available for public use. As a result, this study was exempt from approval by the institutional review board.

Competing Interests

The authors report no financial, consultant, institutional, or other relationships that may lead to bias or competing interests.

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