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ORIGINAL ARTICLE

Inpatient falls after shoulder arthroplasty

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Background: Patient falls are one of the most commonly reported safety incidents in hospitals and an important cause of harm. Despite growing interest in postoperative fall prevention, data on the extent and correlates of falls among elective orthopedic inpatients are sparse and confined to lower limb arthroplasty. We evaluated inpatient fall trends after elective shoulder arthroplasty and identified patient and hospital characteristics associated with the occurrence of falls.

Methods: We used discharge records from the Nationwide Inpatient Sample (2002-2011). Temporal trends were assessed, and multivariate logistic regression modeling was used to characterize factors associated with inpatient falls.

Results: The rate of in-hospital falls increased from 0% in 2002 to 1.7% in 2011, despite a downward trend in length of stay ($P < .001$). Patient characteristics associated with the occurrence of falls included older age, Hispanic race/ethnicity, and lower household income. In decreasing order of magnitude, the comorbidities associated with falls were fluid/electrolyte disorder, opioid use disorder, malnutrition/weight loss, chronic anemia, visual impairment, nonopioid drug use disorder, congestive heart failure, and hearing impairment. Falls were more likely to occur at teaching hospitals and in regions other than the Northeast.

Conclusions: The rate of in-hospital falls after shoulder arthroplasty is increasing despite shorter stays. Many of the identified factors associated with inpatient falls after shoulder arthroplasty are modifiable, either by better preoperative planning and care coordination, by optimized medical management, or by improved patient education and engagement.

Level of evidence: Large Database Descriptive Epidemiology Study
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Keywords: Falls; shoulder arthroplasty; never events; epidemiology; outcomes; Nationwide Inpatient Sample; patient safety

Falls among hospitalized patients are common and costly.[2,38,52] Postoperative in-hospital falls increase morbidity and the potential for litigation[2,10] and are deemed highly preventable by the Centers for Medicare & Medicaid Services (CMS), to the degree that they are now considered a non-reimbursable CMS "never event."[35]

Despite growing interest in fall prevention after surgery, efforts to reduce falls have focused primarily on elderly community dwellers and nursing home residents.[4,13,16,25,28,29,44,50,51] Data on the extent and correlates of falls among elective orthopedic inpatients are sparse and confined to lower limb arthroplasty.[1,27,32,33] In particular, little is known about inpatient falls in the context of shoulder arthroplasty, a procedure whose demand has grown considerably over the past decade,

No Institutional Review Board approval was required for this study. The data are deidentified and commercially available for use.

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even more so than hip and knee replacements.[6,22,24] Within lower limb arthroplasty, Memtsoudis et al[32,33] reported that in-hospital falls are common, especially among elderly and medically infirm patients. However, the role of other potentially important contributing factors (eg, opioid misuse and visual or hearing impairment) was not examined.

Using nationally representative data, we sought to assess inpatient fall rates after shoulder arthroplasty from 2002-2011 and to identify which patient and hospital characteristics merit an increased alertness for the occurrence of falls.

Materials and methods

Data source and study design

We carried out this population-based study using 2002-2011 discharge records from the Nationwide Inpatient Sample (NIS), the largest all-payer inpatient database in the United States.[18] Assembled annually by the Agency for Healthcare Research and Quality, this database contains clinical and resource use information from about 8 million inpatient stays from over 1000 hospitals sampled to approximate a 20% stratified sample of community hospitals nationwide. Discharges are weighted based on the sampling frame to ensure national representativeness.[40] For each discharge record, up to 15 procedures and 25 diagnoses (15 before 2009) are coded using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM).

Identification of sample and definitions

We generated a cohort of patients with an ICD-9-CM primary procedure code for total (81.80, 81.88) or partial (81.81) shoulder arthroplasty.[47] The primary outcome of interest was a fall during hospitalization, as identified by the presence of ICD-9-CM diagnosis code E849.7.[32,33] We limited our analysis to patients undergoing elective procedures, in an attempt to exclude those who fell in an institutionalized setting other than the hospital where the surgery took place.[33]

Covariates

We gathered data on various demographic characteristics such as age, sex, race/ethnicity (white, black, Hispanic, other, unknown), primary health insurance (Medicare, Medicaid, private, other), and median household income in the patient's ZIP code of residence ($1-$38,999, $39,000-$47,999, $48,000-$62,999, and ≥$63,000). On the basis of clinical plausibility and available evidence,[7,15,20,26,33] we selected numerous comorbidities that could potentially affect in-hospital fall risk: visual impairment, hearing impairment, opioid use disorder (abuse or dependence),[34] nonopioid drug use disorder, alcohol use disorder, fluid and electrolyte disorder, chronic anemia, malnutrition/weight loss, and congestive heart failure. Hospital-related variables were teaching status (teaching, nonteaching), location (urban, rural), and geographic region (Northeast, Midwest, South, West). Fall rates (per 1000 shoulder arthroplasties) were reported for all covariates.

Statistical analysis

Multiple logistic regression modeling was performed to identify which factors were independently associated with inpatient falls after shoulder arthroplasty. We entered all covariates into the model simultaneously, without further selection. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). Statistical tests were 2 sided, with $P < .05$ indicating statistical significance.

Results

Among 328,874 patients undergoing elective shoulder arthroplasty, 4130 (1.3%) experienced a fall during hospitalization (Table I). Despite a downward trend in length of stay over the 10-year study period (from 2.7 days in 2002 to 2.2 days in 2011, P for trend < .001), the rate of in-hospital falls increased from 0% in 2002 to 1.7% in 2011 (P for trend < .001; Fig. 1).

After adjustment for potential confounding effects in multivariate modeling (Table I), patient characteristics associated with the occurrence of in-hospital falls were older age (OR of 1.22 [95% CI, 1.10-1.36] for ≥75 years and OR of 1.18 [95% CI, 1.06-1.30] for 65-74 years vs ≤64 years), Hispanic race/ethnicity (OR of 1.34 [95% CI, 1.12-1.60] vs white), and lower household income (OR of 1.27 [95% CI, 1.15-1.40] for $1-$38,999 vs ≥$63,000). In decreasing order of magnitude, the comorbidities associated with inpatient falls consisted of fluid and electrolyte disorder (OR, 3.58; 95% CI, 3.29-3.89), opioid use disorder (OR, 3.33; 95% CI, 1.98-5.59), malnutrition/weight loss (OR, 2.36; 95% CI, 1.71-3.26), chronic anemia (OR, 1.94; 95% CI, 1.53-2.46), visual impairment (OR, 1.85; 95% CI, 1.28-2.67), nonopioid drug use disorder (OR, 1.76; 95% CI, 1.05-2.96), congestive heart failure (OR, 1.57; 95% CI, 1.38-1.79), and hearing impairment (OR, 1.49; 95% CI, 1.19-1.86). Inpatient falls were more likely to occur at teaching hospitals (OR, 1.29; 95% CI, 1.00-1.25) and in regions other than the Northeast.

Discussion

Falls are one of the most commonly reported incidents in hospitals and an important cause of patient harm.[2,46] Despite the interest in postoperative fall prevention and burgeoning demand for shoulder arthroplasty,[6,8,22,24] little is known about the extent and correlates of inpatient falls after this major orthopedic procedure. Preoperative identification of patients at increased risk of falls is important for developing targeted initiatives to prevent this serious adverse event. In this context, we sought to explore inpatient fall rates after elective shoulder arthroplasty from 2002-2011 and to determine patient and hospital factors contributing to falls.

The principal strengths of our study include its large sample size and national representativeness, as well as the use of multivariate regression modeling to minimize confounding. Nonetheless, we acknowledge some important shortcomings

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