

INCIDENCE AND RISK FACTORS FOR 30-DAY READMISSIONS AFTER HIP FRACTURE SURGERY

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ABSTRACT

Background: Unplanned hospital readmission following orthopedic procedures results in significant expenditures for the Medicare population. In order to reduce expenditures, hospital readmission has become an important quality metric for Medicare patients. The purpose of the present study is to determine the incidence and risk factors for 30-day readmissions after hip fracture surgery.

Methods: Patients over the age of 18 years who underwent hip fracture surgery, including open reduction internal fixation (ORIF), intramedullary nailing, hemi-arthroplasty, or total hip arthroplasty, between the years 2012 and 2013 were identified from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. Overall, 17,765 patients were identified. Univariate and multivariate analyses were performed in order to determine patient and surgical factors associated with 30-day readmission.

Results: There were 1503 patients (8.4%) readmitted within 30-days of their index procedure. Of the patients with a reason listed for readmission, 27.4% were for procedurally related reasons, including wound complications (16%), peri-prosthetic fractures (4.5%) and prosthetic

dislocations (6%). 72.6% of readmissions were for medical reasons, including sepsis (7%), pneumonia (14%), urinary tract infection (6.3%), myocardial infarction (2.7%), renal failure (2.7%), and stroke (2.3%). In the subsequent multivariate analysis, pre-operative dyspnea, COPD, hypertension, disseminated cancer, a bleeding disorder, pre-operative hematocrit of <36, pre-operative creatinine of >1.2, an ASA class of 3 or 4, and the operative procedure type were each independently associated with readmissions risk ($p < 0.05$ for each).

Conclusions: The overall rate of readmission following hip fracture surgery was moderate. Surgeons should consider discharge optimization in the at risk cohorts identified here, particularly patients with multiple medical comorbidities or an elevated ASA class, and should focus on wound complications and fall risks in order to minimize readmissions. Further, quality-reporting metrics should account for the risk factors identified here, in order to prevent penalties against surgeons who take on complex patients.

INTRODUCTION

Unplanned hospital readmissions represent a source of substantial expenditure for Medicare beneficiaries. During the twelve month period between 2003 and 2004, 19.6% of Medicare beneficiaries were readmitted within 30-days of their initial hospitalization, resulting in \$17.4 billion of additional expenditure.¹ This staggering expenditure triggered congressional action, and the Centers for Medicare and Medicaid services (CMS) has been authorized to initiate several cost containment measures.^{2,3} Unplanned readmissions were chosen as a key metric, and institutions with elevated readmission rates will be financially penalized.^{2,3} The CMS is collecting data, and public reporting of institutional readmission rates has already begun for total joint arthroplasty, with proposed financial penalties for underperforming institutions set to begin in 2015.^{3,5}

Many patients who sustain a hip fracture are over the age of 65 years.⁶ Thus, these Medicare quality metrics are particularly applicable to this patient population. However, few studies have examined unplanned readmissions after hip fracture surgeries,⁷⁻¹⁰ and most of these have been single center retrospective series. Therefore, the

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Ethical Review Committee Statement: This study received an exemption by the institutional review board at the University of Iowa.

Disclaimer: The American College of Surgeons National Surgical Quality Improvement Program and the hospitals participating in the ACS NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.

purpose of the current study was to report the incidence and risk factors for 30-day unplanned readmissions after hip fracture surgery, from amongst a large, prospectively collected, multi-center cohort. The results should be useful in informing health policy decisions.

METHODS

Data Source

This study received an IRB exemption and was HIPAA compliant. The National Surgical Quality Improvement Program (NSQIP) consists of over 480 hospitals from around the United States, with roughly half private and half academic centers. Data collection is performed by onsite personnel called surgical clinical reviewers (SCR), who prospectively review patient progress notes, operative reports, and post-operative clinic visits in order to identify complications. If a patient has not returned for follow-up the SCR calls the patient directly to inquire about complications, and in this way readmissions that occur at outside hospitals should also be captured. Not all cases from each center are collected. However, a rolling algorithm is used for case selection in order to minimize selection bias. The dataset is routinely audited, with an inter-rater disagreement rate of only 1.56%.¹¹ Overall, NSQIP data is collected with a high fidelity, and the database has been widely accepted as a source of morbidity data across multiple surgical sub-specialties.^{4,12-16}

Patient Cohort

We retrospectively queried this database using International Classification of Diseases, 9th-edition (ICD-9) coding for patients who were admitted between 2012 and 2013 with a primary diagnosis of a hip fracture (ICD-9 820.x), and who underwent operative fixation. Operations are classified in the database by Current Procedural Terminology (CPT) codes. We included cases of hemiarthroplasty (CPT 27125), total hip arthroplasty (CPT 27130), open reduction internal fixation (ORIF) (CPT 27236), plate and screw fixation (CPT 27244), and intramedullary nailing (CPT 27245). We excluded any patient with a pre-operative infection (wound class of 2 or above), pre-operative sepsis, or patients in a coma. In total, this identified 17,765 patients.

STATISTICAL ANALYSIS

The occurrence of an unplanned readmission is specifically recorded by the NSQIP SCR's, and is categorized separately from patients with a planned readmission. The reason for readmission is recorded with an ICD-9 diagnosis code. For our statistical analysis, patients were divided into categories of those with and without an unplanned readmission within 30-days of their index procedure. First, a univariate analysis was conducted in order to identify

unadjusted differences between those two cohorts, using a student's t-test for continuous variables and a chi-squared test for categorical variables. Patients were compared across multiple demographic, surgical, and comorbidity categories (Table I). Significance in this analysis was considered to be a p-value <0.05.

Second, we performed a multivariate analysis in order to compare patient characteristics, while attempting to control for confounders. Any variable from the univariate analysis with a p<0.1 and greater than 80% data completion was included in this analysis. The multivariate model required complete patient data, and thus patients with a missing data-point were necessarily excluded. This left a total of 15,163 patients were included in the multivariate analysis. Statistical significance in this model was considered to be a p-value <0.05. All statistical calculations were conducted with using SAS 9.3 (SAS Institute, Cary, NC).

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RESULTS

Overall, 1,503 out of 17,765 patients (8.5%) were readmitted within 30-days of their index procedure. 721 (48%) of these had no reason for their readmission listed. Of the 782 patients with a reason listed for readmission, 27.4% (214 patients) were for procedurally related reasons, including wound complications (16%), peri-prosthetic fractures (4.5%) and prosthetic dislocations (6%). 72.6% of the readmissions (568 patients) were for medical reasons, including sepsis (7%), pneumonia (14%), urinary tract infection (6.3%), myocardial infarction (2.7%), renal failure (2.7%), and stroke (2.3%) (Table I).

In the univariate analysis, there were multiple differences in comorbidities, demographics, laboratory values, and surgical characteristics between the patients with and without a readmission (Table II). These differences make it difficult to draw conclusions from the univariate analysis. Thus, in an attempt to control for confounders, we subsequently performed a multivariate analysis (Table III). In this multivariate analysis, medical factors that were independently associated with readmissions risk were the

Table I. Univariate Comparison of Patient demographics and procedural characteristics between non-readmitted and readmitted patients*

Characteristic	Not Readmitted n=16262	Readmitted n= 1503	P Value
Demographics			
Age, Mean (SD), yrs	79.87(11.42)	80.52(10.66)	0.0257
Gender			
Female	71.09	66.13	<0.0001
Race			<0.0001
Black	2.87	3.73	
White	73.61	82.97	
Other	23.51	13.31	
BMI (kg/m ²)			0.0546
≤ 35.0	95.39	94.24	
>35	4.61	5.76	
Comorbidities			
Current Alcohol Abuse	4.38	3.85	0.7719
Current Smoker	11.94	13.51	0.0749
Recent Weight Loss	1.35	1.53	0.5569
Dyspnea	6.77	10.91	<0.0001
COPD	10.74	16.1	<0.0001
CHF	3.31	5.72	<0.0001
Hypertension	66.57	75.18	<0.0001
Diabetes	17.1	20.69	0.0004
PVD	2.22	5.38	0.0247
Disseminated Cancer	2.36	3.66	0.0019
Steroid Use	5.65	7.72	0.0011
Bleeding Disorder	16.01	23.55	<0.0001
Dialysis	1.76	3.26	<0.0001
Chemotherapy within 30 Days	1.32	0.77	1
Radiation Therapy w/in 90 Days	0.6	0	1
Prior Operation w/in 30 Days	0.71	2.26	0.0902
ASA Class			<0.0001
1 or 2 – No or Mild disturbance	20.82	11.56	
3 - Severe Disturbance	61.83	63.24	
4 - Life Threatening Disturbance	17.35	25.2	
Operative Variables			
Outpatient	0.31	0.2	0.6242
Emergency Case	33.54	29.74	0.0028
Operative time, hours			
> 4	0.66	1	0.1259
≤ 4	99.34	99	
Total Case Relative Value Units	18.29(2.68)	18.42(3.05)	0.1289
Length of stay, days			0.0018
> 4	61.04	65.14	
≤ 4	38.96	34.86	
Case Type			0.0004
CPT 27125 – Hemiarthroplasty	17.11	18.83	
CPT 27130 Total Hip Arthroplasty	4.24	4.86	
CPT 27236 ORIF	28.78	32.34	
CPT 27244 Plate/Screws	17.64	14.5	
CPT 27245 – IM Rod	32.23	29.47	

*All values listed as percentages except where noted.

Table II. Reasons for 30-day Readmission*

Complications	Cases (No.)	Percentage (%)
Surgical		
Wound		
Superficial SSI	23	2.9
Deep SSI	67	8.6
Wound Dehiscence	8	1.0
Hematoma/Seroma	26	3.3
Any Wound	124	16
Procedural Related		
Malunion	4	0.5
Periprosthetic Fracture	35	4.5
Prosthesis Dislocation	47	6.0
Other Hardware Complication	4	0.5
Any Surgical Related Reason	214	27.4
Medical		
Pain		
Procedural Related Pain	17	2.2
Hematologic		
Deep Vein Thrombosis	25	3.2
Pulmonary Embolism	21	2.7
Post-Operative Anemia	27	3.5
Arterial Thrombosis	2	0.3
Systemic Infection		
Sepsis	55	7.0
Septic Shock	23	2.9
UTI	49	6.3
Respiratory Infection	109	13.9
Distant Cellulitis	4	0.5
Non-specific illness	10	1.3
Neurologic		
Stroke	18	2.3
Syncope	3	0.4
Seizure	1	0.1
Delirium	14	1.8
Dementia	1	0.1
Depression	1	0.1
Intra-Cranial Hemorrhage	1	0.1

Complications	Cases (No.)	Percentage (%)
Systemic Disturbance		
Electrolyte imbalance	7	0.9
Oncology Related	1	0.1
Lymphedema	2	0.3
Hypoglycemia	4	0.5
Alcohol Withdrawal	1	0.1
Encephalopathy	7	0.9
Gastrointestinal		
Ileus/Bowel Obstruction	24	3.1
GI Bleed	21	2.7
Abdominal Pain	1	0.1
C. Diff Infection	9	1.2
Esophagitis	4	0.5
Diverticulitis	3	0.4
Cardiac		
Cardiac arrest	4	0.5
Myocardial infarction	21	2.7
Cardiac arrhythmia	10	1.3
Heart failure	15	1.9
Chest pain	4	0.5
Peripheral Vascular Disease	1	0.1
Hypotension	1	0.1
Tachycardia	1	0.1
Respiratory		
Pneumonitis	2	0.3
Pleural Effusion	1	0.1
Pulmonary Hypostasis	1	0.1
Acute Respiratory Failure	11	1.4
Dyspnea	1	0.1
Renal		
Acute Renal Failure	21	2.7
Hematuria	1	0.1
Urinary Retention	2	0.3
Trauma		
Accidental Fall	3	0.4
Pressure Ulcer	3	0.4
Any Medical Reason	568	72.6

*Overall percentage contribution excludes patients admitted for unknown reasons (n = 721). SSI = Surgical Site Infection, UTI = Urinary Tract Infection, NOS = Not Otherwise Specified, CPRS = Complex Regional Pain Syndrome, COPD = Chronic Obstructive Pulmonary Disorder, GI = Gastrointestinal

presence of pre-operative dyspnea (OR of 1.3, 95% CI of 1.1-1.6), COPD (OR of 1.3, 95% CI of 1.1-1.5), hypertension (OR of 1.2, 95% CI of 1.1-1.4), a history of disseminated cancer (OR of 1.5, 95% CI of 1.1-2.0), pre-operative renal insufficiency with a serum creatinine greater than 1.2 (OR of 1.2, 95% CI of 1.1-1.4), and a history of a bleeding disorder (OR of 1.3, 95% CI of 1.1-1.5). Laboratory values that were identified as independent risk factors included a pre-operative hematocrit of less than 36% (OR 1.2, 95% CI of 1.1-1.4). Overall medical status, as measured by the

patient's American Society of Anesthesia (ASA) score, was also independently associated with readmissions risk. Lastly, we considered intra-medullary nailing to be the least invasive procedural option. When this procedure was used as a reference, patients who underwent hemiarthroplasty (OR of 1.3, 95% CI of 1.1-1.5), total hip arthroplasty (OR of 1.4, 95% CI of 1.1-1.9), or open reduction and internal fixation (OR of 1.2, 95% CI of 1.1-1.4), were each at independently higher risk of 30-day readmissions.

Table III. Risk Factors for 30-Day Readmission As Identified By Multivariate Analysis

Variable	Odds Ratio (95% Confidence Interval)
Preoperative Dyspnea (Yes v. No)	1.3 (1.1-1.6)
COPD (Yes v. No)	1.3 (1.1-1.5)
Hypertension (Yes v. No)	1.2 (1.1-1.4)
Disseminated Cancer (Yes v. No)	1.5 (1.1-2.0)
Bleeding Disorder (Yes v. No)	1.3 (1.1-1.5)
Preoperative Anemia (Hct of ≤ 36 v. >36)	1.2 (1.1-1.4)
Renal Insufficiency (Cr of >1.2 v. ≤ 1.2)	1.2 (1.1-1.4)
ASA Class of 3 (v. 1 or 2)	1.5 (1.2-1.7)
ASA Class of 4 (v. 1 or 2)	1.7 (1.4-2.1)
Operative Procedure	
Hemiarthroplasty (v. IM Nail)	1.3 (1.1-1.5)
Total Hip Arthroplasty (v. IM Nail)	1.4 (1.1-1.9)
ORIF (v. IM Nail)	1.2 (1.1-1.4)

DISCUSSION

Overall, few prior studies have reported on 30-day re-admission risks in patients undergoing operative fixation of a hip fracture. Thus, the purpose of our study was to report the incidence and risk factors for unplanned readmissions after this common procedure, by utilizing a large, prospectively collected multi-center database. Several of our findings merit further discussion.

The first purpose of our study was to identify the incidence of unplanned 30-day readmissions after hip fracture surgery. Overall, we reported an incidence of 8.5%. This percentage is lower than those from previous reports. Kates *et al* reported on 129 30-day readmissions amongst a 1,081 patient cohort (11.9%) from a level III trauma center.⁷ French *et al.* reported on 7,579 hip fracture readmissions within 30-days, from a cohort of 41,331 patients (18.3%), identified from the Veterans Health Administration database,⁸ while Harstedt *et al.* reported on 86 patients readmitted within 30-days from a 272 patient cohort (32%). There are several possible reasons for this discrepancy. First, we have included all patients greater than 18 years of age, and the younger patients in our cohort may be less likely to be readmitted, in part because they fewer comorbidities. Overall, however, the average ages in our study were 80.5 and 79.9 years for the readmitted and not-readmitted groups, respectively. Thus, the cohort is largely composed of geriatric hip fractures, and the impact of the younger patients is likely small. More importantly, our study takes data from 2012-2013, whereas the prior reports are from the 1990's and early 2000's. Over the last 5-10 years many hospitals have focused on discharge optimization and have placed substantial emphasis on

minimizing readmissions.^{1,2} Thus, the contemporary data presented in our study may indicate that these programs have had some success, and that readmission rates have decreased over time.

The second purpose of this study was to identify risk factors for unplanned readmissions. The majority of the patients in our study were readmitted for medical reasons (72.6%). This number compares favorably with those from prior studies.

Giusti *et al* reported that higher medical comorbidity burden, and poor functional status were predictors of readmissions.¹⁷ In the Kates *et al.* study, 81.4% were readmitted for medical reasons. Similarly, French *et al.* concluded that readmissions were primarily due to comorbid medical conditions, rather than from hospital acquired or surgical complications.⁸ Sepsis (7%), pneumonia (14%), urinary tract infection (6.3%), myocardial infarction (2.7%), renal failure (2.7%), and stroke (2.3%) were among the most common medical reasons for readmission in our study.

Similarly, the majority of the independent risk factors for readmission that we identified were medical comorbidities. Patients with pre-operative dyspnea, COPD, hypertension, disseminated cancer, anemia, renal insufficiency, a bleeding disorder, or an ASA class of 3 or 4 were each found to be at higher risk. Unfortunately for surgeons and hospitals, many of these risk factors are not modifiable. Hip fracture surgery is frequently done on an urgent or semi-urgent basis, which leaves little time for optimization of chronic medical conditions. Indeed, most modern literature supports early operative intervention for minimizing morbidity risk,^{17,18} and thus operative delay for medical optimization may actually be worse for the patient. Therefore, quality metrics should take these risk factors into account when calculating expected readmissions, in order to avoid unduly penalizing surgeons who take on challenging cases.

In addition to the medical factors identified above, the type of surgical procedure was also found to be an independent risk factor for readmission. Patients treated with an intramedullary nail device had the lowest risk for readmission, and each of the other surgical options was associated with a higher risk. However, it is important to note that many hip fractures, particularly displaced fractures of the femoral neck, may not be amenable to intramedullary nailing, due to a high risk of avascular necrosis. Furthermore, our study was not designed to assess fracture healing or long-term functional outcomes, and thus this finding should not be used to dictate treatment decisions. Rather, we feel that the surgical procedure type should be one of the factors considered when assessing surgeon and hospital readmission rates. Our data indicates that the different surgical procedures have different risk profiles, and therefore should be considered separately in

statistical models of surgeon and hospital performance.

Our study does have several weaknesses. First, our outcomes data is limited to a time window of 30-days. Many medical complications that can lead to readmission, such as wound infection, non-union requiring revision surgery, or DVT/PE can occur after 30-days, and these would not be captured in our dataset. However, CMS has emphasized the 30-day target in their quality metrics, and thus we feel it is a reasonable time-point for evaluation in this study. Second, nearly half of the cohort did not have a reason for readmission listed. Thus, our analysis of the causes of readmission could potentially be biased if the remaining group was not representative of the entire cohort. However, all of the patients were included in our multivariate analysis of risk factors for readmission, and thus our primary conclusions on the incidence and risk factors for readmissions remains unaffected by this missing data. Furthermore, the causes of readmissions we identified are very similar to those reported previously in the literature, and we feel that the additional data-points would be unlikely to change the overall percentages.

Overall, the rate of 30-day readmissions following hip fracture surgery was moderate. Surgeons should consider discharge optimization in the at-risk cohorts identified here, particularly patients with multiple medical comorbidities or an elevated ASA class, and should focus on wound complications and fall risks in order to minimize readmissions. Further, quality-reporting metrics should account for the risk factors identified here, in order to prevent penalties against surgeons who take on complex patients.

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