RESEARCH ARTICLE

Longer Length of Stay Increases 1-year Readmission Rate in Patients Undergoing Hip Fracture Surgery

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Abstract

Background: Proximal femur fractures are prevalent among the elderly and associated with substantial morbidity, mortality, and early readmission. Early readmission is gaining popularity as a measure of quality of hospital care and can lower reimbursement. A better understanding of the patient and treatment characteristics associated with readmission may help inform program improvement initiatives. This study tested the primary null hypothesis that length of stay is not associated with higher rates of readmission within 30 days and 1 year in patients having operative treatment of a proximal femur fracture, accounting for discharge destination and other factors.

Methods: We performed a secondary analysis on a database of 1,061 adult patients, age 55 years or older, admitted for treatment of a proximal femoral fracture in an urban level 2 trauma center. Multivariable logistic and linear regression models were created to account for the influence of age, sex, race, BMI, American Society of Anesthesiologists score (ASA), fracture type (AO/OTA), fixation type, operating surgeon, operative duration, and discharge destination.

Results: In multivariable logistic regression analysis, treatment by surgeon 4 was independently associated with a lower 30-day readmission rate. Higher one-year readmission rate was associated with a longer length of stay, ASA class 3, 4 and 5.

Conclusion: The observation that patients cared for by specific surgeons are more likely to experience readmission within one year of surgery for a fracture of the proximal femur, suggests that program improvements to identify and disseminate best practices might reduce readmission rates.

Level of evidence: III

Keywords: Discharge destination, Hip fracture, Length of stay, Surgery

Introduction

Proximal femur fractures are prevalent among the elderly and they are associated with substantial morbidity and mortality and notable readmission rates (1–3). Early readmission is becoming an increasingly important measure because it is costly (1). Readmission within 30 days of discharge is being used as a benchmark for quality of hospital care, and is tied to financial reimbursement by the Centers for Medicare and Medicaid Services (CMS) (4). A better understanding of the patient and treatment characteristics associated with readmission may help inform efforts to limit readmissions (5).

It is unclear whether an increased length of initial hospital stay might decrease the odds for readmission, or whether it is a sign of problems that can potentially lead to readmission. Given that longer inpatient hospital

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stays also increase costs, it is helpful to know whether patients can be discharged sooner without affecting the chance of readmission.

A large database of patients that had surgery for a hip fracture provided us the opportunity to analyze whether the length of stay in the hospital affects readmission. This study tested the primary null hypothesis that in patients age 55 years or older having operative treatment of a proximal femur fracture length of stay is not associated with higher rates of readmission within 30 days and 1 year, accounting for discharge destination and other factors. Additionally, we tested the secondary null hypothesis that there is no correlation between length of stay and in-hospital mortality.

Materials and Methods

Study design

We performed a secondary analysis on a database of 1,061 adult patients age 55 years or older, admitted for treatment of a proximal femoral fracture in an urban level 2 trauma center. The exclusion criteria for this study were: high-energy trauma, pelvic or acetabulum fractures, femoral shaft fractures more than 5cm below the lesser trochanter, and multiple fractures. Pre- and post-operative radiographs were reviewed and classified by three orthopedic surgeons according to the AO/OTA fracture classification (6). Fractures were classified into non-displaced and displaced femoral neck fractures; stable, unstable and reverse obliquity intertrochanteric femur fractures; and subtrochanteric femur fractures. Fixation type was added to the database through operative reports, intraoperative fluoroscopy, and post-operative radiographs. Moreover, the patient characteristics age, sex, race (black, white or other), American Society of Anesthesiologist (ASA) classification and Body Mass Index (BMI) were entered into the database by a research nurse.

Total length of in-hospital stay and mortality were recorded in addition to the discharge destination [Table 1]. Patients categorized as ASA 1 and 2 were pooled; and the same was done to ASA 4 and 5. All subtrochanteric fractures were consolidated into one group. All other fractures were analyzed at the subgroup level. The least frequent surgical fixation methods (with fewer than 50 cases) were combined into one group. This category includes the following surgeries: total hip arthroplasty with cemented femoral component, uncemented total hip arthroplasty, short nail non-locked and screw with side plate (dynamic hip screw or equivalent). Surgeons who performed fewer than 50 operations were placed into a single group. The discharge destinations 'hospice', 'transfer', and 'long-term care' were combined, as these numbers were too low to analyze.

Statistical analysis

In order to detect differences in 30-day and 1-year readmission rates and mortality, multivariable logistic regression models were created, accounting for the variables age, sex, race, BMI, ASA, fracture type (AO/OTA), fixation type, operating surgeon, length of stay,

Table 1. Patients' demographics

Variables	Value
Patients included	1,061
Age (yrs, range)	80±9.8 (55-106)
Female	763 (72%)
Race	
White	941 (89%)
Black	55 (5.2%)
Other	65 (6.1%)
ASA	
1	2 (0.2%)
2	158 (16%)
3	658 (65%)
4	195 (19%)
5	3 (0.3%)
BMI (Kg/m^2, range)	24±5.2 (13-55)
Length of stay (days, range)	5.9±3.2 (1-36)
Readmission	
days 30	92 (8.7%)
year 1	290 (27%)
Discharge destination	
Home health	46 (4.4%)
Hospice	(2.6%) 27
Long-term care	11 (1.1%)
Rehab	328 (31%)
Routine	33 (3.2%)
Skilled nursing facility	567 (54%)
Transfer	30 (2.9%)
AO classification	
31-A1	229 (22%)
31-A2	253 (24%)
31-A3	84 (7.9%)
31-B1	94 (8.9%)
31-B2	291 (27%)
31-B3	78 (7.4%)
32-A	16 (1.5%)
32-B	13 (1.2%)
32-C	3 (0.28%)
Fixation	
Hemi-arthroplasty pressfit	310 (29%)
Short nail locked	287 (27%)
Long nail locked	(18%) 186
Hemi-arthroplasty cemented	71(6.7%)

Continuation of table 1.	
Long nail nonlocked	67 (6.3%)
Percutaneous screws	67 (6.3%)
Other	73 (6.9%)
Surgeon	
1	171 (16%)
2	159 (15%)
3	133 (13%)
4	121 (11%)
5	118 (11%)
6	69 (6.5%)
7	67 (6.3%)
8	59 (5.6%)
9	50 (4.7%)
Other	113 (11%)

Continuous variables as mean (±standard deviation); discrete variables as number (percentage).

and discharge destination. Bivariate analysis was used to screen for statistically significant variables to include in the multivariable model of factors associated with mortality. Length of stay was put into this model, regardless of statistical significance. In all models, a *P<0.05* was considered statistically significant. ASA was excluded from the multivariable model due to collinearity.

An apriori power analysis showed that a sample of 1,070 subjects would provide 90% statistical power, with alpha set at 0.05, for a regression with eleven predictors if length of stay would account for 2% or more of the variability in readmission rate.

Results

In multivariable logistic regression analysis, treatment by surgeon 4 was independently associated with a lower 30-day readmission rate (Odds Ratio [OR], 0.29; 95% Confidence Interval [CI], 0.088 - 0.94; Standard Error [SE], 0.17; *P=0.04*) [Table 2]. Higher one-year readmission rate was associated with a longer length of stay (OR, 1.1; CI, 1.0 - 1.1; SE, 0.027; *P=0.038*), ASA class 3 (OR, 1.6; CI, 1.0 – 2.5; SE, 0.40; *P=0.049*), classes 4 and 5 (OR, 2.3; CI, 1.4 – 4.0; SE, 0.64; *P= 0.002*) [Table 3].

Table 2. Multivariable logistic regression analysis of factors associated with 30-day readmission

Variables	Odds ratio	95% confidence interval (lower bound - upper bound)		Standard error	*P* value	Pseudo R^2
Length of stay (days)	1.1	0.98	1.1	0.038	0.17	0.054
Discharge destination						
Home	*reference value*					
Rehab	0.76	0.26	2.2	0.42	0.62	
Skilled nursing facility	1.1	0.40	3.2	0.61	0.81	
Long term Care	0.21	0.021	2.1	0.25	0.18	
Age	1.0	0.97	1.0	0.013	0.80	
Sex						
Female	*reference value*					
Male	1.1	0.65	1.9	0.29	0.72	
Race						
White	*reference value*					
Black	0.77	0.26	2.2	0.42	0.63	
Other	0.29	0.068	1.2	0.21	0.089	
BMI	0.99	0.95	1.0	0.025	0.83	
ASA						
1 & 2	*reference value*					
3	0.95	0.47	1.9	0.33	0.87	
4&5	1.5	0.68	3.4	0.62	0.30	
Anesthesia						
General	*reference value*					

Continuation of table 2.

Other	1.4	0.29	6.3	1.1	0.70
Surgical time	1.0	0.99	1.0	0.0046	0.67
Fixation type					
Hemi-arthroplasty pressfit	*reference value*				
Short nail locked	1.0	0.22	4.9	0.82	0.97
Long nail locked	1.6	0.31	8.0	1.3	0.58
Hemi-arthroplasty cemented	0.66	0.24	1.9	0.35	0.44
Long nail nonlocked	1.7	0.29	11	1.6	0.55
Percutaneous screws	0.13	0.016	1.1	0.14	0.063
Other	0.90	0.25	3.3	0.59	0.88
Fracture type					
31-A1	*reference value*				
31-A2	1.0	0.51	2.1	0.37	0.94
31-A3	0.76	0.25	2.3	0.43	0.62
31-B1	1.9	0.33	10	1.6	0.48
31-B2	1.6	0.35	7.1	1.2	0.56
31-B3	1.6	0.30	8.3	1.3	0.59
32-ABC	0.64	0.12	3.4	0.55	0.60
Surgeon					
1	*reference value*				
2	0.71	0.32	1.6	0.29	0.40
3	0.72	0.31	1.7	0.31	0.44
4	0.29	0.088	0.94	0.17	**0.04**
5	0.67	0.27	1.7	0.31	0.39
6	0.73	0.27	2.0	0.37	0.54
7	0.82	0.29	2.3	0.44	0.71
8	0.45	0.14	1.5	0.28	0.19
9	0.42	0.11	1.6	0.29	0.21
Other	1.3	0.56	2.9	0.53	0.56

Bold indicates statistical significance, *P < 0.05*.

Table 3. Multivariable logistic regression analysis of factors associated with 1-year readmission.

Variables	**Odds ratio**	**95% confidence interval (lower bound - upper bound)**		**Standard error**	***P value***	**Pseudo R^2**
Length of stay (days)	1.1	1.0	1.1	0.027	**0.038**	0.045
Discharge destination						
Home	*reference value*					
Rehab	1.6	0.76	3.2	0.57	0.22	
Skilled nursing facility	1.7	0.85	3.5	0.62	0.13	
Long term Care	0.45	0.13	1.5	0.28	0.20	
Age	1.0	0.98	1.0	0.0084	0.66	
Sex						

Continuation of table 3.

Female	*reference value*				
Male	0.99	0.70	1.4	0.17	0.94
Race					
White	*reference value*				
Black	1.3	0.71	2.4	0.41	0.39
Other	0.56	0.29	1.1	0.19	0.087
BMI	1.0	0.97	1.0	0.015	0.85
ASA					
1 & 2	*reference value*				
3	1.6	1.0	2.5	0.40	**0.049**
4&5	2.3	1.4	4.0	0.64	**0.002**
Anesthesia					
General	*reference value*				
Other	1.3	0.49	3.4	0.64	0.60
Surgical time	1.0	0.99	1.0	0.0028	0.36
Fixation type					
Hemi-arthroplasty pressfit	*reference value*				
Short nail locked	0.58	0.24	1.4	0.27	0.24
Long nail locked	0.51	0.20	1.3	0.24	0.16
Hemi-arthroplasty cemented	1.1	0.58	2	0.35	0.79
Long nail nonlocked	0.46	0.16	1.3	0.24	0.14
Percutaneous screws	0.71	0.30	1.7	0.31	0.43
Other	0.77	0.34	1.7	0.32	0.53
Fracture type					
31-A1	*reference value*				
31-A2	1.1	0.68	1.7	0.24	0.78
31-A3	1.3	0.70	2.6	0.44	0.37
31-B1	0.42	0.15	1.2	0.22	0.097
31-B2	0.73	0.32	1.7	0.31	0.47
31-B3	0.39	0.14	1.0	0.20	0.06
32-ABC	1.5	0.59	3.9	0.72	0.40
Surgeon					
1	*reference value*				
2	1.1	0.65	1.8	0.29	0.74
3	1.0	0.57	1.7	0.28	0.99
4	0.97	0.51	1.8	0.32	0.92
5	0.70	0.38	1.3	0.22	0.24
6	1.3	0.68	2.5	0.43	0.43
7	1.4	0.71	2.8	0.50	0.33
8	0.76	0.36	1.6	0.29	0.47
9	1.6	0.71	3.4	0.62	0.27
Other	1.4	0.78	2.5	0.41	0.27

Bold indicates statistical significance, *$P < 0.05$*.

In bivariate analysis, higher in-hospital mortality was associated with male sex (*P=0.008*) and higher ASA class (P, 0.008) [Table 4]. In multivariable logistic regression analysis, male sex was associated with higher in-hospital mortality (OR, 3.5;CI, 1.4 – 8.9; SE, 1.7; *P=0.007*) [Table 5].

Tabel 4. Bivariate analysis of factors associated with mortality

Variables	Alive	Deceased	*P value*
Length of stay (days)	5.9±3.2	7.1±5.5	0.099
Age	80±9.8	78±8.6	0.75
Sex			**0.008**
Female	755 (99%)	8 (1.0%)	
Male	287 (96%)	11 (3.7%)	
Race			0.61
White	922 (98%)	19 (2.0%)	
Black	55 (100%)	0 (0%)	
Other	65 (100%)	0 (0%)	
BMI	24±5.2	24±5.6	0.81
ASA			**0.008**
1 & 2	160 (100%)	0 (0%)	
3	649 (99%)	9 (1.4%)	
4 & 5	190 (96%)	8 (4.0%)	
Anesthesia			0.067
General	1018 (98%)	17 (1.7%)	
Other	22 (92%)	2 (8.3%)	
Surgical time	57±41	54±22	0.79
Fixation type			0.24
Hemi-arthroplasty pressfit	304 (98%)	6 (1.9%)	
Short nail locked	284 (99%)	3 (1.0%)	
Long nail locked	183 (98%)	3 (1.6%)	
Hemi-arthroplasty cemented	67 (94%)	4 (5.6%)	
Long nail nonlocked	66 (99%)	1 (1.5%)	
Percutaneous screws	67 (100%)	0 (0%)	
Other	71 (97%)	2 (2.7%)	
Fracture type			0.079
31-A1	222 (97%)	7 (3.1%)	
31-A2	251 (99%)	2 (0.79%)	
31-A3	83 (99%)	1 (1.2%)	
31-B1	94 (100%)	0 (0%) 0	
31-B2	287 (99%)	4 (1.4%)	
31-B3	74 (95%)	4 (5.1%)	
32-ABC	31 (97%)	1 (3.1%)	
Surgeon			0.50
1	168 (98%)	3 (1.8%)	

Continuation of table 4.

2	156 (98%)	3 (1.9%)
3	130 (98%)	3 (2.3%)
4	116 (96%)	5 (4.1%)
5	117 (99%)	1 (0.85%)
6	69 (100%)	0 (0%)
7	67 (100%)	0 (0%)
8	59 (100%)	0 (0%)
9	48 (96%)	2 (4.0%)
Other	111 (98%)	2 (1.8%)

Bold indicates statistical significance, *P* < 0.05.

Table 5. Multivariable logistic regression analysis of factors associated with mortality

Variables	Odds ratio	95% confidence interval (lower bound - upper bound)		Standard error	*P* value	Pseudo R^2
						0.048
Length of stay (days)	1.1	0.98	1.2	0.048	0.15	
Sex						
Female	*reference value*					
Male	3.5	1.4	8.9	1.7	**0.007**	

Bold indicates statistical significance, *P* < 0.05.

Discussion

Readmission to the hospital is costly and often avoidable (1, 4). Readmissions are common among older, more infirm patients with decreased functional status who are treated for a fracture of the proximal femur (5). It's not clear whether a longer length of initial hospital stay might limit the potential for readmission, or whether it is a marker for problems that might lead to readmission. Considering the high costs associated with lengthy hospital stays, it is useful to study whether patients can stay fewer days without increasing the readmission rate. Our analysis of patients age 55 and older undergoing hip fracture surgery found that a longer length of in-hospital stay was associated with a higher 1-year readmission rate, accounting for other factors. Length of stay was not associated with higher mortality rates.

Accounting for patient and provider factors, we found that longer length of in-hospital stay was not associated with higher 30-day readmission rates, yet it was associated with higher 1-year re-admission rates. One might presume that patients who are readmitted more than 30 days after the discharge date are not readmitted for direct complications from surgical treatment, such as surgical site infection. Therefore, our finding that length of stay increases long-term readmissions might indicate that patients who require more extensive care during their in-hospital stay are more frail, and have poorer long-term health outcomes. Although it might be expected that ASA classification adequately predicts poor health outcomes, our findings may suggest that there are other factors associated with frailty that are not sufficiently captured by the ASA classification system in patients recovering from hip fractures. Longer length of stay was not associated with higher 30-day readmission rates, a finding that is conflicting with a previous study on 41,331 veterans that found that found a weak correlation between these variables (each additional day of in-hospital length of stay increased the likelihood of readmission by 1%). Another large database study on 8,434 patients with geriatric hip fractures found a correlation between the length of stay and 30-day readmission rates (7). The varying findings may represent differences between patient populations, inclusion criteria, or research methodology. Despite these conflicting findings, none of these studies found higher readmission rates among patients who had a shorter length of stay. In order to lower the increasing costs of health care, a faster discharge may be justifiable after surgical treatment of hip fractures, although further studies are needed that address patient-reported outcomes in addition to readmission rates. Interestingly, one of the surgeons had significantly lower odds for 30-day readmission, which supports dissemination of best practice guidelines. The finding of surgeon-to-surgeon variation in postsurgical outcomes in patients with hip fracture is supported by previous studies that found differences between surgeon subspecialty and patient volume (8-10).

Length of stay was not associated with in-hospital mortality. Previous studies addressed length of stay or mortality as outcomes, although few used length of stay as a predictor for mortality. Since we found that there is no association between these two variables, it may be concluded that life-threatening complications from surgery may occur at any moment during recovery, and the odds may not increase with longer stay. We found that men have higher odds of in-hospital mortality, confirming previous studies on this topic (11, 12). Since these gender differences have been found to be unrelated to age or comorbidities, future studies are warranted to address this gender disparity in patients with hip fractures.

Our study should be considered with the following limitations in mind. First, the data used in this study were collected in an urban level 2 trauma center and may not generalize to other settings. Second, we analyzed all-cause readmission, and therefore patients may have been readmitted for health problems unrelated to the injury or surgery. Third, we could not include ASA as a predictor for mortality, since these were collinear. Although it could not be concluded in the multivariable model, it can be concluded that this is a strong predictor of in-hospital mortality. Finally, due to the low numbers of patients with certain fixation techniques (such as uncemented total hip arthroplasty) and fracture types (subtrochanteric fractures), these groups needed to be pooled, which caused heterogeneity. Therefore, no meaningful conclusions can be drawn from the 'other' group.

Our current study suggests that care by specific surgeons is independently associated with higher 1-year readmission rates. Our findings in combination with previous studies do not support the concept that faster discharges after surgery are associated with higher all-cause readmission rates, and future prospective studies are merited that address outcomes from patients who are discharged sooner after surgery. The surgeons included in this database have varying levels of experience, habits of practice, and preferences with regards to discharge disposition. Indeed, the surgeon-to-surgeon variations suggest that program improvement initiatives and implementation of best practices might reduce all-cause readmission rates.

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