

Determinants of Length of Stay in Geriatric Intertrochanteric Femur Fractures

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ABSTRACT

Objective: To investigate the clinical and administrative factors associated with hospital length of stay in geriatric patients with operative intertrochanteric femur fractures.

Design: Retrospective cohort study.

Setting: Level I tertiary facility and Community Hospital.

Participants: A total of 152 patients 65 years of age or older who were operatively treated for intertrochanteric fractures between 2014-

2019.

Intervention: Transfusion in operative intertrochanteric femur fractures.

Main Outcome Measurements: The primary outcome was prolonged length of stay (LOS) defined as greater than or equal to 5 days.

Results: A total of 115/152 (75%) had preoperative anemia defined as hematocrit < 36.0% for women or 41.0% for men. The prevalence of transfusion was 26% in these geriatric patients with operative intertrochanteric fractures. Among the cohort, 87 (57%) participants had a prolonged length of stay. The average length of stay was not different between those with or without anemia (6.6 days versus 6.5 days, $p = 0.85$). Among those participants admitted on a Wednesday, 89% had a prolonged length of stay ($p = 0.001$). Anesthesiology Specialty Association (ASA) classification was significantly associated with length of stay ($p < 0.04$). Location of surgery was significantly associated with a prolonged length of stay ($p = 0.001$).

Conclusion: The present study suggests preoperative hematocrit is not associated with a prolonged LOS in geriatric patients with hip surgery. Wednesday admissions and ASA scores were independent variables associated with LOS and should be considered in bundled payments and discharge planning from the time of admission.

Level of Evidence: Level III

Key words: Geriatrics; Intertrochanteric femur fractures; Length of stay; Blood transfusion; Anemia

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INTRODUCTION

Hip fractures in the geriatric population represent a significant public

health issue in the United States (US) with high morbidity, mortality, and healthcare costs^[1-5]. Hospitalization, rehabilitation, and skilled nursing facilities represent the three main drivers of injury cost^[6]. According to the Healthcare Cost and Utilization Project (HCUP), the cost of treatment in 2016 for hip fractures in the US was estimated to be 18 billion dollars^[7]. Hospital length of stay (LOS) is one of the factors used to identify and risk stratify patients that are at risk for readmission or death within thirty days^[6,8].

Several studies evaluated administrative data with regards to LOS with a limited number of studies including both patient variables and administrative data. The comorbidities and disability associated with hospital LOS after hip fracture highlight the complexity of caring for an aging population^[9-14]. Brauer *et al.* showed that comorbidities have increased in geriatric patients with intertrochanteric femur fractures^[15]. Evidence suggest there is an increased risk of postoperative events that occur in geriatric patients with anemia undergoing noncardiac surgery^[16]. Two studies on patients with hip fractures showed that anemia was associated with increased length of stay (LOS)^[17,18]. Gruson *et al.* analyzed data collected between 1991 and 1997 from more than 350 patients included in the prospective database of the Geriatric Hip Fracture Research Group at the Hospital for Joint Diseases. They found that the adjusted risk of mortality was five times higher for patients with severe anemia after hip fracture surgery. Total length of acute hospital stay was 13.3 days in the Gruson *et al.* study^[17].

In 2017, according to the Healthcare Cost and Utilization Project, the average LOS in America was 5 days^[7]. The shorter LOS is likely related to national policy level changes that were endorsed in 2008 as a model for healthcare reform^[19]. As of 2010, provisions for bundled payments were included in the Patient Protection and Affordable Care Act (ACA)^[20]. The limitation of using the results from pre-ACA healthcare models is that practices in perioperative management have evolved. In 2013, the Centers for Medicaid and Medicare Services implemented the Bundled Payments for Care Improvement (BPCI) initiative to increase quality and care coordination at a lower cost to Medicare^[21-23]. There is a need for modern studies to investigate the factors that drive BPCI. Research on clinical and administrative characteristics are critical in this population because of the high one-year mortality (30%)^[24].

The purpose of this study was to analyze outcome data to improve patient identification and risk stratification to optimize strategy for effective perioperative management. The aims of the current study were to assess the effect of clinical and administrative factors such as preoperative anemia, ASA scores, and day of admission on hospital LOS in patients undergoing surgery for intertrochanteric fractures. A secondary aim was to describe the difference between length of stay at the level I tertiary facility versus a community hospital. We hypothesized clinical characteristics such as anemia could be used to risk stratify patients to guide bundle eligibility in the ongoing Bundled Payments for Care Improvement initiative.

METHODS

Study design, setting, and participants

After Institutional Board Review (IRB) approval, a retrospective chart review was performed. All patients who had surgery for intertrochanteric femur fracture (OTA/AO 31A) at a Level I tertiary facility or Community Hospital over a 5-year period (2014-2019) were identified using Current Procedural Terminology (CPT) code 27245 (treatment of intertrochanteric, peritrochanteric, or subtrochanteric femoral fracture with intramedullary implant, with

or without interlocking screws and/or cerclage)^[25,26]. There were no operations performed that matched CPT 27244 (using screws and sides plates for stable intertrochanteric fractures) during this time period. Hip fracture diagnosis was confirmed with standard radiographs of the affected hip. Exclusion criteria included patients < 65 years of age, high energy trauma, follow-up < 365 days, and patients who did not have surgery or who had revision fixation for a previous hip fracture.

Outcomes

The primary outcome was prolonged length of stay. We measured the length of stay in days from date of admission to date of discharge. We evaluated the distribution of the hospital length of stay and determined a threshold of 5 days for the group labeled as prolonged length of stay. The group of participants with LOS < 5 days was used for comparison. This definition is consistent with a similar study^[27]. Independent variables assessed included living arrangements, tobacco use, preoperative ambulatory status, injury mechanism, presence of other injuries, preoperative echocardiogram, postoperative weight-bearing status, weekday admitted, average preoperative hematocrit, and red blood cell transfusion. Preoperative anemia was defined as < 0.0% for women and 41.0% for men. The average preoperative hematocrit value was recorded before surgery.

Administrative factors included weekday of admission, day of discharge, location and time to surgery. Living arrangements were categorized as apartment, house, and rehabilitation or skilled nursing facility. ASA classification was grouped by location of surgery on admission. Preoperative ambulatory status was categorized as non-ambulatory, dependent ambulator (requires intermittent or continuous physical assistance from caregiver in order to ambulate), household ambulator, or community ambulator. Presence of other injuries was recorded binomially (isolated or polytraumatic). Home anticoagulation were recorded as none, aspirin, warfarin, clopidogrel, new oral anticoagulants (NOAC) or enoxaparin. Postoperative weight-bearing status was categorized as non-weightbearing, 50% weight-bearing or weight-bearing as tolerated.

Statistical methods

The Kruskal-Wallis test was used to analyze relationships between categorical independent variables and the continuous dependent variable, LOS; whereas chi-square and Fisher's exact tests were used when comparing prolonged length of stay. Spearman correlation coefficients were used to investigate the relationship between hematocrit levels and LOS. All statistical analysis was performed using SAS Version 9.4 (SAS Institute Inc., Cary, NC). P-values of ≤ 0.05 (two-sided) were considered statistically significant.

RESULTS

One-hundred and fifty-two patients were included in this analysis. The average age was 80.4 years (+/- 8.6 years). A total of 115/152 (75%) participants had preoperative anemia (Table 1). Among the group, 87 (57%) participants had a prolonged length of stay, defined as greater than or equal to 5 hospital days. In the group with a prolonged LOS, the mean LOS was 8.8 days (SD +/- 4.8). In the group with a LOS < 5 days, the mean LOS was 3.8 days (SD +/- 0.7). Home anticoagulation was not associated with prolonged LOS ($p = 0.11$). Day of discharge was significantly associated with location of surgery with 97% of discharges from the Level I tertiary care hospital and 90% of Community Hospital discharges occurring Monday through Friday ($p = 0.04$). Results indicate that higher ASA ($p =$

0.04), week day of admission ($p < 0.001$), and location of surgery ($p < 0.001$) were significantly associated with prolonged LOS (Table 2 and Table 3).

As shown in Table 1, the groups with anemia and without anemia were comparable. Comparisons of patient characteristics and clinical variables grouped by length of stay found no significant associations between age, gender, race, method of injury, tobacco use, or use of preoperative echocardiogram (Table 2). There were also no significant associations between mechanism of injury, laterality and preoperative echocardiogram with prolonged LOS. There was a significant association between length of stay and ASA class ($p < 0.04$).

Table 3 presents information about timing and location of surgery with participants grouped by prolonged length of stay or length of stay 5 days or less. Weekday of admission was significantly related to LOS with Wednesday representing the most common day of admission associated with prolonged LOS and Friday representing the lowest with a prolonged length of stay ($p < 0.001$). There was no association with the day of discharge ($p = 0.81$). However, there was an association with prolonged LOS based on location of surgery (Level 1 tertiary care facility versus a Community Hospital) (58.8 vs 41.2% prolonged length of stay, $p < 0.001$). Table 4 demonstrates longer time to surgery is significantly associated with prolonged LOS (30 vs 16 hours; $p = 0.009$). Surgical case time was not associated with prolonged LOS ($p = 0.24$).

Seventy patients were managed at the Level 1 tertiary care hospital compared to 79 patients treated at the Community Hospital. ASA class was significantly associated with location of surgery ($p < 0.001$) (Table 5).

Table 1 Comparison of patient characteristics (n, % or mean, SD) of available demographic and clinical variables: grouped by anemia.

Characteristics	Patients with anemia* [No. (%)]	Patients without anemia [No. (%)]
Count	115 (75)	37 (25)
Age (y), mean +/- SD	80.4 +/- 8.6	80.4 +/- 9.5
Gender		
Male	57 (49.6)	4 (10.8)
Female	58 (50.4)	33 (89.2)
Laterality		
Right	57 (49.6)	22 (59.5)
Left	58 (50.4)	15 (40.5)
Outpatient/Home Anticoagulation		
None	51 (44.6)	17 (45.9)
Aspirin	40 (34.8)	12 (32.4)
Warfarin	8 (6.9)	2 (5.4)
Clopidogrel	11 (9.6)	1 (2.7)
New Oral Anticoagulants	4 (3.5)	4 (10.8)
Enoxaparin	1 (0.9)	1 (2.7)
Method of Injury		
Same level fall	108 (93.9)	35 (94.6)
Fall from height	4 (3.5)	2 (5.4)
Tobacco use		
None	105 (91.3)	31 (83.8)
Tobacco use	10 (8.7)	6 (16.2)
Preoperative echocardiogram		
No	91 (79.1)	30 (81.1)
Yes	24 (20.9)	7 (18.9)
Length of stay (days), mean	6.6 (4.6)	6.5 (3.8)

*Anemia defined by preoperative hematocrit $< 36.0\%$ for women or 41.0% for men.

DISCUSSION

The aim of this study was to assess the clinical and administrative factors related to hospital length of stay in geriatric patients with operative intertrochanteric femur fractures. We report on patients with geriatric hip fractures due to their high morbidity and mortality. Hospital type, time to surgery, discharge policies, and clinical pathways have been shown to influence outcomes in patients with hip fracture surgery^[28]. In our study, preoperative hematocrit was not associated with LOS suggesting additional factors such as day of admission and ASA scores be considered as modern risk factors for LOS from the time of admission.

Previously studied factors shown to affect hospital LOS in hip fracture patients include ASA classification^[14,29], preoperative cardiac testing^[30], weekday of admission^[30], Abbreviated Mental Test Score (AMTS)^[14], preoperative mobility status^[14], and surgery timing^[31]. The available literature on preoperative anemia and blood transfusion in relation to hospital length of stay suggest these factors increase length of stay^[17,32-34]. We found that when patients with hematocrit levels in the range of anemia were compared to

Table 2 Comparison of patient characteristics (n, % or mean, SD) of available demographic and clinical variables: grouped by length of stay.

Characteristic	Prolonged length of stay [No. (%)]	Length of stay < 5 days [No. (%)]	P value
Count	87 (57)	65 (43)	
Age (y), mean +/- SD	80.1 +/- 8.7	80.8 +/- 9.0	0.64
Gender			0.3
Male	38 (43.7)	23 (35.4)	
Female	49 (56.3)	42 (64.6)	
Race			0.059
Black or African American	16 (18.4)	6 (9.2)	
White	68 (78.2)	59 (90.8)	
Missing information	3 (3)	-	
Laterality			0.8
Right	46 (52.9)	33 (50.8)	
Left	41 (47.1)	32 (49.2)	
Method of Injury			0.28
Same level fall	80 (92.0)	63 (96.9)	
Fall from height	4 (4.6)	2 (3.1)	
Tobacco use			0.33
None	76 (87.4)	60 (92.3)	
Tobacco use	11 (12.6)	5 (7.7)	
Preoperative echocardiogram			0.07
No	66 (75.9)	55 (84.6)	
Yes	21 (24.1)	10 (15.4)	
ASA Class			0.04
1	2 (3)	-	
2	2 (3)	1 (1)	
2E	-	1 (1)	
3	57 (67.1)	34 (53.1)	
3E	7 (8.2)	14 (21.9)	
4	15 (17.6)	12 (18.8)	
4E	4 (4.7)	0	
Red blood cell transfusion			0.68
No	63 (72.4)	49 (75.4)	
Yes	24 (27.6)	16 (24.6)	

Abbreviation: ASA, anesthesia specialty association classification.

patients with hematocrit above the threshold, there was no significant difference between length of stay (6.6 vs 6.5 days). One possible explanation for this finding is that current perioperative protocols are managing for low hematocrit levels adequately so that it is less of a factor related to a prolonged length of stay, when defined as 5 days or more. Conversely, administrative factors reported in the current study that were associated with prolonged length of stay included weekday of admission and location of surgery. In our study, patients admitted on Wednesday and location of surgery were associated with prolonged length of stay revealing a potential area of inefficiency within the healthcare system. Furthermore, our study identified that in both surgical centers less than 10% of patients were discharged on the weekend.

Traditionally, in order to be considered a “qualifying inpatient hospital stay” Medicare requires a hospital stay of at least three midnights to qualify for coverage of subsequent postacute care in a skilled nursing facility^[35]. Grebla *et al.* found that this long-standing policy may now be inappropriately lengthening hospital stays for patients who could be potentially discharged sooner if the three-day qualifying stay requirement was eliminated. The “Wednesday Effect” would support the need for improved care coordination. This phenomenon describes a period in which patients admitted on a Wednesday are potentially subjected to unnecessarily prolonged hospital stays. For patients admitted on a Wednesday the pressure to meet the three-midnight requirement to qualify for Medicare combined with limited case management availability on the weekends,

limited admission capacity at skilled nursing and rehabilitation facilities may unnecessarily delay the decision to discharge resulting in prolonged LOS. Potential consequences of this trend include increased spending on avoidable hospital care and increased patient exposure to both nosocomial and iatrogenic complications^[36]. A study comparing hospital and post-acute skilled nursing facility utilization among Medicare Advantage enrollees found that the elimination of the three-day stay requirement resulted in savings on Medicare Advantage plans in addition to declines in average hospital length of stay warranting further investigation on the effects of waiving of the three-day requirement^[35].

Contrary to previous studies on the effects of anemia and blood transfusion in relation to hospital length of stay, the current study did not show an association between receiving a transfusion and a prolonged length of stay in geriatric patients with intertrochanteric femur factors revealing change in medical practice, and why our study only looked at 5 years of data^[17,32-34]. Additionally, preoperative hematocrit seems to be a marker of frailty which is consistent with other studies^[37].

With an increased focus on health care quality to determine predictors of length of postoperative hospital stay, we believe our study to be useful in defining both surgical and administrative actions to reduce length of stay. One such action is the implementation of modern pre and postoperative surgical protocols for hip surgery. In 2015 a previous study investigating factors affecting delay to surgery (DTS) and length of stay for patients with hip fracture found that patients admitted Thursday through Saturday had longer DTS (mean, 2.2-2.7 days) compared to patients admitted on other days (mean 1.7-1.8)^[30]. Following the induction of modernized surgical protocols orthopaedists are now able to routinely reduce delays to surgery to under 24 hours. Optimizing time to hip surgery based on medical condition medically stable patients creates potential for improved financial, operational, and clinical outcomes by minimizing healthcare costs and risk for nosocomial infection.

In the current study, we did not observe an association between preoperative anemia and prolonged LOS. Given that our cohort included patients 65 and older, this result was surprising as advanced age carries greater risk of morbidity and mortality following surgical procedures^[38]. The combination of reduced red bone

Table 3 Timing and location of surgeries grouped by length of stay.

Week day and location	Prolonged length of stay [No. (%)]	Length of stay < 5 days [No. (%)]	P value
Day of Admission			<.001
Sunday	6 (6.9)	10 (15.4)	
Monday	10 (11.5)	14 (21.5)	
Tuesday	14 (16.1)	6 (9.2)	
Wednesday	25 (28.7)	3 (4.6)	
Thursday	13 (14.9)	9 (13.9)	
Friday	5 (5.8)	13 (20.0)	
Saturday	14 (16.1)	10 (15.4)	
Day of Discharge			0.81
Sunday	3 (3.5)	4 (6.2)	
Monday	16 (18.4)	10 (15.4)	
Tuesday	19 (21.9)	12 (18.5)	
Wednesday	19 (21.9)	10 (15.4)	
Thursday	13 (14.9)	14 (21.5)	
Friday	15 (17.2)	13 (20.0)	
Saturday	2 (2.3)	2 (3.1)	
Location			<.001
Level I tertiary facility	50 (58.8)	20 (31.3)	
Community Hospital	35 (41.2)	44 (68.8)	

Bolded variables are significant at <0.05.

Table 5 Comparison of ASA class on admission grouped by location of surgeries.

ASA Class	Level 1 Center No. (%)	Community Hospital No. (%)	P value <0.001
1	0	2 (2.6%)	
2	0	3 (3.9%)	
2E	0	1 (1.3%)	
3	44 (61.9%)	47 (60.3%)	
3E	1 (1.4%)	20 (25.6%)	
4	23 (32.4%)	4 (5.1%)	
4E	3 (4.2%)	1 (1.3%)	

Bolded variables are significant at <0.05.

Table 4 Comparison of available hospital metrics and health indicators: grouped by length of stay.

	Prolonged length of stay			LOS < 5 days			P value
	n	Mean +/- (SD)	Range (Min- Max)	n	Mean +/- (SD)	Range (Min-Max)	
LOS, days	87	8.8 +/- 4.8	5-34	65	3.8 +/- 0.7	2-5	-
Time to surgery, hours	85	29.6 +/- (41.1)	2.4-341	62	15.7 +/- (8.3)	3-38	0.009
Case time, hours	85	1.35 +/- (0.6)	1-3	64	1.2 +/- (0.5)	1-3	0.24

Abbreviations: OR, operating room; LOS, length of stay; Bolded variables are significant at <0.05.

marrow constituents and inadequate hematopoietic compensatory mechanisms for correction of anemia also influence recovery time in elderly populations^[39]. Furthermore, blood loss is a well-known complication in hip surgery with over 50% of patients requiring the need for allogeneic blood transfusions^[40]. Our findings suggest higher ASA scores are significantly associated with prolonged LOS supporting their well established use as a single metric to risk stratify for postoperative medical complications^[41]. Given our findings, it is therefore likely elderly patients with operatively treated hip fractures with preoperative anemia represent a population for which medical optimization may benefit.

Given the complexity of today's healthcare system, both clinical and administrative efforts such as the advent of surgical protocols, rapid discharge pathways, and hip bundle payments for care improvement (BPCI) been created to promote value-based care. Postoperative protocols are playing an important role in optimizing patient safety and healthcare spending with a growing body of literature supporting the use of rapid discharge pathways^[42]. These clinical care pathways have been shown to reduce hospital LOS, care costs, and improve patient safety across orthopaedic institutions throughout the United States^[42-44]. A study comparing cohorts with and without defined post-acute care pathways for hip arthroplasty showed orthopaedic surgeons who followed post-acute care pathways decreased cost and utilization rates of discharge services (inpatient rehabilitation facilities, skilled nursing facilities, and home health)^[45].

Traditionally, orthopaedic surgeons have been compensated in a fee-for-service model where each action in the clinical-care process is reimbursed. However, in an effort to mitigate rising medical costs and incentivize value-based care the Centers for Medicaid and Medicare Services implemented the Bundled Payments for Care Improvement initiative^[21-23] which helps to align incentives for providers while reducing cost of care and improving outcomes^[43,44]. In the orthopaedic bundle-payment model, providers and facilities receive a flat fee for each clinical event, such that reimbursement is driven by the delivery of both high-quality and cost-conscious care so that any costs savings is rewarded to the provider^[46]. In our study, ASA classification was associated with location of surgery and LOS. We hypothesize that ASA score could be used to risk stratify patients at an institution and could influence eligibility the reimbursement per patient in updated payment models in the BPCI.

Some limitations of the present study must be taken into consideration. A prospective study with controls would be necessary to draw generalizable conclusions about the factors that can facilitate rapid discharge protocols. As a retrospective study, selection bias and potential unmeasured confounders are inherent to the study design. Additionally, reasons for surgical blood loss such as hematoma formation, redistribution of fluids, and length of incision were not investigated which could have explained unaccounted perioperative blood loss^[47]. The findings related to transfusion and length of stay was not statistically significant, likely secondary to low power, with a total of 40 participants receiving any transfusion. This correlates with previous studies^[37]. A limitation related to the implications for bundled payments is that length of stay represents one piece of the 90-day episode of care.

The current study suggests that preoperative hematocrit was not associated with length of stay in geriatric patients with intertrochanteric femur fractures. Implementation of defined rapid discharge pathways and use of ASA scores to determine bundled payment eligibility may reduce health care costs and mark another step towards reducing delays to treatment in geriatric patients and hospital LOS with intertrochanteric femur factors.

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