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Implementation of a Multidisciplinary Preoperative Protocol for Geriatric Hip Fractures Improves Time to Surgery at a Level III Trauma Center

Jacob R. Meyer, MS[1], Ryan E. Earnest, MD[2], Brian M. Johnson, MD[1], Andrew M. Steffensmeier, MD[1], Dheer A. Vyas, MD[3], and Richard T. Laughlin, MD[1]

Abstract

Introduction: Hip fractures are common among the elderly, and delays in time to surgery (TTS) and length of stay (LOS) are known to increase mortality risk in these patients. Preoperative multidisciplinary protocols for hip fracture management are effective at larger trauma hospitals. The purpose of this study is to evaluate the effect of a similar multidisciplinary preoperative protocol for geriatric hip fracture patients at our Level III trauma center. **Materials and Methods:** In this single-center retrospective study, patients aged 65 and older who were admitted from March 2016 to December 2018 (pre-protocol group, Cohort #1, n = 247) and from August 2021 to September 2022 (post-protocol group, Cohort #2, n = 169) were included. Demographic information, TTS, and LOS were obtained and compared using Student's *t*-test and Chi-square testing. **Results:** There was a significant decrease in TTS in Cohort #2 compared to Cohort #1 ($P < .001$). There was a significant increase in LOS in Cohort #2 compared to Cohort #1 ($P < .05$), but when comparing a subset of Cohort #2 (Subgroup 2B, patients admitted from May to September 2022 when the effects of COVID-19 were likely dissipated) to Cohort #1, there was no significant difference in LOS ($P = .13$). For patients admitted to skilled nursing facilities (SNF), LOS in Cohort #2 was significantly longer than in Cohort #1 ($P = .001$). **Discussion:** In general, Level III hospitals have fewer perioperative resources compared to larger Level I hospitals. Despite this fact, this multidisciplinary preoperative protocol effectively reduced TTS which improves mortality risk in elderly patients. LOS is a multifactorial variable, and we believe the COVID-19 pandemic was a significant confounder that reduced available SNF beds in our area which prolonged the average LOS in Cohort #2. **Conclusion:** A multidisciplinary preoperative protocol for geriatric hip fracture management can improve efficiency of getting patients to surgery at Level III trauma centers.

Keywords

geriatric trauma, hip fracture, time to surgery, multidisciplinary, protocol, COVID-19

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[1]Department of Orthopaedic Surgery, University of Cincinnati College of Medicine, Cincinnati, OH, USA
[2]Department of Surgery, University of Cincinnati College of Medicine, Cincinnati, OH, USA
[3]Department of Anesthesiology, University of Cincinnati College of Medicine, Cincinnati, OH, USA

Corresponding Author:
Jacob R. Meyer, Department of Orthopaedic Surgery, University of Cincinnati College of Medicine, 3230 Eden Ave, Cincinnati, OH 45267-0552, USA.
Email: meyer3j7@mail.uc.edu

Introduction

It has been reported that up to 86% of hip fractures occur in individuals aged 65 years and older.[1] Hip fractures are not only very common, but they are associated with significant financial burden, loss of independence, morbidity, and mortality.[2-7] Recent studies indicate that

the 1-year mortality of hip fracture patients is as high as 22%,[8] and after a hip fracture, only about one third of patients are expected to return to pre-fracture levels of independence and mobility function.[5] Therefore, efficient management of these patients is critical for improving overall patient outcomes.

Two of the biggest variables influencing outcomes after hip fractures are delays in time to surgery (TTS) and length of stay (LOS) in the hospital.[9,10] Studies have shown that hip fracture patients operated on within 48 hours had a 20% lower 1-year mortality risk,[11] and that delays in TTS over 48 hours are associated with an increase in the 30-day and 1-year mortality by 41% and 32%, respectively.[12] This has led institutions and physicians to implement goals of treatment for hip fractures to under 48 hours from the time of admission. Other factors that are correlated with delays in TTS and LOS include American Society of Anesthesiologists (ASA) score,[13] additional preoperative testing, surgeon availability, operating room (OR) availability, and specialist consultation.[14] These factors are particularly important when considering the type of hospital, ie larger Level I trauma centers vs Level III trauma centers and smaller community hospitals. Larger hospitals tend to have dedicated orthopaedic trauma rooms and more access to OR time,[15-17] whereas smaller hospitals tend to have more variable OR time and surgeon availability which can markedly increase TTS and LOS. In addition, the COVID-19 pandemic has had a large influence on geriatric hip fracture management. In particular, the effect of discharge disposition after the pandemic has likely changed based on the availability of rehabilitation beds and/or skilled nursing facilities (SNFs). As the population ages, more patients are likely to need SNF following hip fracture surgery.

Due to the number of variables that can influence hip fracture outcomes, a multidisciplinary, streamlined protocol for preoperative hip fracture care is often desired so that multiple healthcare teams can work in parallel rather than sequentially to deliver a predictable, high level of care.[18] Hospitals that have implemented such protocols have demonstrated their efficacy in improving many factors such as TTS, LOS, post-operative complication rates, hospital readmissions, infections, cost per patient, and overall mortality.[19-23] Current data evaluating these protocols is predominantly from Level I trauma centers which have more resources and greater patient volume compared to smaller trauma centers. There is little data on the implementation of this type of protocol at smaller hospitals. The purpose of our study was to evaluate the effect of a similar multidisciplinary preoperative protocol for geriatric hip fracture patients at our university-affiliated Level III trauma center.

Materials and Methods

The institutional review board approved this retrospective study as a quality improvement initiative. Retrospective chart review was conducted for all patients aged 65 years and older who underwent operative fixation of an isolated femoral neck, intertrochanteric, or pertrochanteric hip fracture, and who were admitted to our Level III trauma center from March 2016 to December 2018 (pre-protocol group, Cohort #1) and from August 2021 to September 2022 (post-protocol group, Cohort #2). Demographics, ASA score, medical comorbidities, mortality, and discharge disposition were recorded. Surgery, admission, and discharge times were also recorded and used to calculate TTS and LOS. The time it took to receive the results of additional cardiac testing was calculated from the respective orders. Regarding additional cardiac testing, transthoracic echocardiogram (TTE) is not available on the weekends at our hospital unless, through multidisciplinary discussion, it is deemed emergent. It is also important to note that the COVID-19 outbreak was declared a global pandemic on March 11, 2020, and therefore occurred between the 2 time periods that we collected our data.

Hip Fracture Protocol

The usual care at our institution prior to implementation of the protocol was that geriatric hip fracture patients were admitted by the hospitalist service for general resuscitation, stabilization, and evaluation for surgery. Orthopaedic surgery was consulted at this time. The hospitalist service would order all preoperative testing, which included cardiac tests (eg TTE), when deemed necessary. Once a patient was called to surgery, the anesthesiologist would then evaluate the patient in the preoperative holding area, typically within an hour of surgery. Anesthesiology would only evaluate the patient before they are called to the preoperative holding area if there were specific concerns brought to their attention beforehand. Geriatric patients often have several comorbidities requiring further evaluation prior to surgery, specifically surrounding their cardiopulmonary status. Often, patients were found to be not medically optimized for surgery, and at times needed additional testing or medical optimization prior to undergoing general anesthesia. Given the lack of time to act and change outcomes within such close proximity to surgery, this often led to surgical delays, case cancellations, and overall increases in LOS.

The intervention protocol begins with every hip fracture patient being initially evaluated in the emergency department by the trauma service. They are responsible for general resuscitation, optimizing medications in the preoperative period, and determining if any advanced preoperative testing is necessary to optimize patients for

surgery. Consults are obtained from orthopaedic surgery and the hospitalist service, who ultimately manages the patient's comorbid medical conditions. The anesthesiology team introduced a perioperative services physician (POSP) team that was not present in the past. The duties of this team include preoperative evaluation of patients while on the floor and to make recommendations to optimize patients for surgery alongside the other aforementioned services. The patient is admitted to the trauma, orthopaedic surgery, or internal medicine service. The case is typically scheduled for the following day depending on OR availability. The POSP team evaluates the patient beginning at 7 AM on the day of planned surgery to ensure necessary testing has been completed and the patient is medically optimized for surgery. The anesthesia team, in conjunction with the trauma team, determines whether advanced cardiac testing (eg TTE) is necessary in order to give the patient anesthesia. This advanced testing is only obtained for patients as recommended by the latest clinical practice guidelines from the American College of Cardiology (ACC) and the American Heart Association (AHA).[24] The anesthesia and trauma teams jointly assist in timing of surgery, taking into consideration surgical urgency, patient risks, and optimization.

The patients were split into 2 cohorts: Cohort #1 includes the patients evaluated prior to implementation of the protocol, and Cohort #2 includes the patients evaluated after implementation of the protocol. Within each cohort, there was one subgroup, 1A or 2A, which included the patients who received additional preoperative cardiac workup prior to surgery. A second subgroup of Cohort #2, Subgroup 2B, included patients who were admitted from the period May 2022 to September 2022.

Statistical Analysis

The 2 patient cohorts and their subgroups were compared using two-sided Student's *t*-test to compare mean values of TTS, LOS, and time to result of additional preoperative cardiac testing. Chi-square testing was used to assess categorical measurements of differences in discharge to SNF or home depending on ASA score.

Results

A total of 247 patients were included in Cohort #1 and 169 patients were included in Cohort #2. Complete demographic data is presented in Table 1.

As depicted in Table 2, there was a significant decrease in TTS between Cohort #1 and Cohort #2 ($P < .001$). There was also a significant increase in LOS between Cohort #1 and Cohort #2 ($P < .05$). When comparing Cohort #1 and Subgroup 2B, there was still a significant ($P < .001$) decrease in TTS, but there was no significant difference ($P = .13$) in LOS (Table 3).

In Cohort #1, 221 (89.5%) patients were discharged to a SNF, 15 (6.1%) were discharged home, and 11 (4.4%) were discharged to other locations (inpatient rehab, extended-care facility, etc.). In Cohort #2, 119 (70.4%)

Table 1. Demographics Data for Patients in Cohort #1 and #2.

	Cohort #1	Cohort #2	
	n = 247	n = 169	*P*-Value
Age (y)	84.13 ± 8.06	81.70 ± 9.86	<.05
Female gender	177 (71.7%)	115 (68.0%)	.42
BMI (kg/m^2)	24.33 ± 4.72	25.05 ± 5.42	.15
Active smoker	19 (7.7%)	19 (11.2%)	.21
Comorbid conditions			
Dementia	70 (28.3%)	46 (27.2%)	.80
COPD	26 (10.5%)	16 (9.5%)	.72
Diabetes mellitus	48 (19.4%)	40 (23.7%)	.30
Cardiovascular disease	206 (83.4%)	146 (86.4%)	.41
Cerebrovascular disease	16 (6.5%)	31 (18.3%)	<.05
Cancer	16 (6.5%)	40 (23.7%)	<.05
ASA score[a]			.35
1	0 (.0%)	0 (.0%)	
2	32 (13.2%)	24 (14.2%)	
3	164 (67.8%)	122 (72.2%)	
4	46 (19.0%)	23 (13.6%)	
5	1 (.4%)	0 (0%)	

[a]There was no obtainable ASA score for 4 patients in Cohort #1.

patients were discharged to a SNF, 20 (11.8%) were discharged home, and 30 (17.8%) were discharged to other locations. When evaluating the LOS between cohorts specifically for patients who were discharged to a SNF, the LOS for patients in Cohort #2 was significantly ($P = .001$) longer than in Cohort #1. There was no significant difference ($P = .55$) in LOS between cohorts for patients who were discharged home. Within Cohort #1, the LOS for patients going to a SNF after discharge was significantly longer than the LOS for patients who went home ($P < .05$). The same was true for Cohort #2 ($P = .001$). This is depicted in Table 2.

As shown in Table 4, there was no significant difference in ASA score for patients who were discharged to SNF vs home (Cohort #1: $P = .51$; Cohort #2: $P = .46$). When comparing patients with the same ASA score between cohorts, there was a significantly lower number of patients with an ASA score of 3 who were discharged to a SNF in Cohort #2 ($P < .05$), but no significant difference between cohorts for patients with an ASA score of 2 or 4 ($P > .05$).

There were 42 patients in Cohort #1 (Subgroup 1A) and 36 patients in Cohort #2 (Subgroup 2A) who received additional preoperative cardiac testing via TTE. There was no significant difference ($P > .05$) in either LOS or TTS between these subgroups, but in Subgroup 2A, there was a significant ($P = .007$) decrease in the time it took for TTE reports to be available for providers to review (Table 3).

Discussion

Two of the most influential factors known to increase mortality risk of geriatric hip fracture patients are extended LOS and delays in TTS - factors which are both differentially impacted by other variables such as lack of OR availability,[14] ASA score, additional preoperative testing, and pre-existing comorbidities.[13] The type of hospital a patient is admitted to is also influential as larger Level I hospitals often have dedicated orthopaedic trauma rooms allowing for shorter admission-to-surgery times, shorter LOS,[16,25] and more OR access overall. They also tend to have greater resources for hip fracture management such as more widely available preoperative cardiac testing and post-operative rehabilitation services necessary for appropriate discharge disposition. In contrast, smaller Level

Table 2. Outcome Measures for Cohorts #1 and #2.

	Cohort #1	Cohort #2	
	n = 247	n = 169	*P*-Value
Time to surgery (hours)	28.16 ± 22.1	20.64 ± 13.5	**<.001**
Length of stay (hours)	141.7 ± 60.24	161.9 ± 88.6	**.01**
LOS, discharge to SNF	141.15 ± 55.6	169.57 ± 85.6	**.001**
LOS, discharge to home	111.42 ± 43.7	101.35 ± 50.8	.55
LOS, discharge to SNF vs home within each cohort	$P < .05$	$P = .001$	
Discharge disposition			
SNF	221 (89.5%)	119 (70.4%)	
Home	15 (6.1%)	20 (11.8%)	
Other	11 (4.4%)	30 (17.8%)	

Table 3. Subgroup Analysis.

	Cohort #1	Subgroup 2B	
	n = 247	n = 48	*P*-Value
Cohort #1 vs Subgroup 2B			
LOS (hours)	141.7 ± 60.24	166.57 ± 110.4	.13
Time to surgery (hours)	28.16 ± 22.1	19.28 ± 11.9	**<.001**
	Cohort #1	Cohort #2	
Subgroup 1A vs Subgroup 2A	n = 42	n = 36	
LOS (hours)	158.39 ± 71.8	169.32 ± 91.1	.56
Time to surgery (hours)	34.9 ± 24.7	29.98 ± 17.1	.19
Time to result of additional cardiac testing (hours)	11.15 ± 8.2	6.4 ± 6.7	**.007**

Table 4. ASA score vs Discharge Disposition.[a]

Cohort #1	SNF	Home	*P*-Value
ASA = 2	29 (13%)	2 (14%)	
ASA = 3	148 (68%)	11 (79%)	
ASA = 4	40 (19%)	1 (7%)	
Total	217	14	
			.51
Cohort #2			
ASA = 2	18 (15%)	4 (20%)	
ASA = 3	88 (73%)	15 (75%)	
ASA = 4	15 (12%)	1 (5%)	
Total	121	20	
			.46

Same ASA score, Cohort #1 vs Cohort #2			
	Cohort #1	Cohort #2	P-value
ASA = 2			
SNF	29	18	
Home	2	4	
			.18
ASA = 3			
SNF	148	88	
Home	11	15	
			.02
ASA = 4			
SNF	40	15	
Home	1	1	
			.28

[a]11 patients from Cohort #1 and 28 patients from Cohort #2 were discharged to other locations (inpatient rehab, extended-care facilities, etc.) and were not included in this analysis.

III hospitals tend to have fewer perioperative resources as well as variable OR and surgeon availability, thereby contributing to increases in TTS and LOS. Due to this multifactorial nature of geriatric hip fracture care, many institutions have implemented standardized multidisciplinary protocols to ensure consistent outcomes.[19-23] The purpose of this study was to evaluate a similar multidisciplinary protocol involving trauma surgery, hospitalist, and orthopaedic surgery services for care of geriatric hip fracture patients at our Level III trauma center.

Since delays in TTS carry an increased mortality risk,[9,12] a standard goal across institutions is for a TTS of less than 48 hours. Our results demonstrate that the implementation of this protocol significantly decreased TTS to a mean value of 20.6 hours, a value well below the 48-hour goal. TTS prior to implementation was still below the 48-hour mark at an average of 28.2 hours, but this further improvement in TTS after the protocol illustrates its effectiveness in streamlining the preoperative process.

Despite a decreased TTS in the post-protocol group, the LOS was increased in our study. The reason for this is unclear, but given the numerous variables that can influence LOS, it cannot simply be attributed to the protocol alone. Additionally, since the protocol has already shown to significantly expedite the preoperative process, the increased LOS must be due to other factors in the post-operative period. We believe that one such factor is the COVID-19 pandemic which was a significant confounder that led to a decreased availability of SNF beds - a variable that is directly related to the increased LOS we observed.

At our institution, this protocol was initiated in August 2020, and data from Cohort #2 was collected from August 2021 to September 2022. Amidst the COVID-19 pandemic, hospital operations were already stressed. Initiating a new protocol at any point would naturally require some time for clinical teams to adjust to the new process, subsequently resulting in a lag time before seeing the desired results. By initiating a new protocol in 2020 and collecting data in 2021 when the effects of the pandemic are still being felt within an already-stressed hospital system, one can only expect that lag time to be prolonged. After initial analysis revealed the increased LOS in Cohort #2 and postulating that it was largely due to COVID-19, we performed a secondary analysis of a subset of Cohort #2 (Subgroup 2B) that included only patients admitted from May to September 2022 (a period where the effects of COVID-19 have more than likely dissipated) with the hypothesis that the LOS in these patients would not significantly differ from the LOS in Cohort #1. Analysis revealed that there was no significant difference in LOS between these groups. This supports our hypothesis that COVID-19 was a large confounding variable that was inflating the average LOS in our post-protocol group. In contrast, however, other studies have demonstrated that LOS was decreased during the pandemic.[26-29] So the question still remains: how exactly did COVID-19 affect our study, and why was LOS increased post-protocol? It is difficult to precisely measure the effects of COVID-19 on our study, but one possible explanation for the prolonged LOS in the post-protocol group is the difficulty in getting patients discharged to rehabilitation centers (ie SNFs). As the population ages, more geriatric patients are likely to need some form of rehabilitation prior to returning home. Some may not be able to return home at all due to social factors such as family support and the type of home (older homes may have narrowed stairways, smaller bathrooms, and may not be a safe environment). After the pandemic, in our area, there have also been staffing issues impacting the number of beds available in rehabilitation centers. We believe this is a significant contributor and a confounding variable leading to the extended LOS observed in the post-protocol group. This theory is supported by our

results which demonstrated a significant increase in LOS in Cohort #2 for patients who were discharged to a SNF, but no significant difference in LOS between the cohorts for patients who were discharged home, as patients who are going home are not under any formal COVID-19-related restrictions. There is minimal literature investigating the differences in LOS depending on discharge disposition, so further exploration of this topic may potentially elucidate some important modifiable factors for geriatric hip fracture care in the post-operative period.

Additional preoperative workup has also been shown to increase LOS in geriatric hip fracture patients.[30] However, among patients who received additional preoperative cardiac testing in our study, there was no significant difference in either LOS or TTS. There was a significant decrease in the time it took for the results of such testing to be available to providers in Cohort #2, which may further support the beneficial effect that the protocol has on streamlining the preoperative process, but given that the LOS and TTS among these patients was not significantly different from Cohort #1, the clinical significance of this benefit is unclear.

The effects of ASA score on discharge disposition were also investigated, but in our study ASA score did not seem to play a significant role. There were significantly less patients with an ASA score of 3 in Cohort #2, but the impact of this is unclear and this difference may be due to the difference in sample sizes between cohorts.

It is important to emphasize that the preoperative protocol we implemented is a modified version of a similar protocol that was implemented at our university-affiliated Level I trauma hospital.[23] The main difference is that at our Level III center, the trauma service is responsible for general resuscitation and preoperative evaluation, whereas at our Level I center, trauma is not involved and instead all patients are admitted to the orthopaedic surgery service. Additionally, at our Level III center, anesthesia is consulted and evaluates the patient beginning at 7 AM each morning to determine their readiness for surgery and the time of day it can be done; while at our Level I center, anesthesia performs a preoperative evaluation after the patient is admitted to and consulted by orthopaedic surgery. In the study at our Level I center, the protocol was successful in decreasing LOS and time to medical readiness for surgery.[23] We saw different results in our study with a significant decrease in TTS and time from order to result of additional cardiac testing. These positive results we obtained despite altering the protocol demonstrate the ways that modifications to a standardized multidisciplinary protocol can be made to effectively optimize patient care at a lower-volume Level III trauma center.

There are some limitations with our study. As a retrospective chart review, we relied on correct documentation in the electronic medical record as well as manual data collection from researchers. With multiple researchers and multiple providers documenting on the same patients, there is an increased chance for inconsistencies in data collection. Secondly, the sample sizes of some subgroups are small and therefore limit the strength of conclusions that can be made. Increasing the sample sizes of cohorts and their subgroups would increase the statistical power and allow for stronger conclusions from our data.

Conclusion

In this study, we describe a standardized, multidisciplinary protocol for preoperative workup of geriatric hip fracture patients at our Level III trauma center. We demonstrate that implementation of this protocol led to a statistically significant decrease in TTS and the time from order to result of additional preoperative cardiac testing. This study highlights the effectiveness of a multidisciplinary team approach in expediting the preoperative process and demonstrates that it can be similarly effective at smaller Level III centers just as it is at larger Level I centers. This study also highlights the multifactorial nature of LOS as a variable, in particular the differential impact that discharge disposition can have on it. Overall, the standardization of preoperative management of geriatric hip fracture patients is an effective method for improving care and optimizing patient outcomes.

Declaration of Conflicting Interests

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Ethical Approval

The Institutional Review Board approved this retrospective study as a quality improvement initiative.

ORCID iDs

Jacob R. Meyer https://orcid.org/0000-0002-5155-5167
Ryan E. Earnest https://orcid.org/0009-0002-7498-704X

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