

Implementation of a Multidisciplinary “Code Hip” Protocol is Associated with Decreased Time to Surgery and Improved Patient Outcomes

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Abstract

Background: The purpose of this study is to report outcomes data based on the implementation of a “Code Hip” protocol, a multidisciplinary approach to the care of fragility hip fracture patients focussing on medical optimization and early operative intervention. We hypothesized that implementation of this protocol would decrease time from presentation to surgical intervention and improve outcomes based on short term post-operative data. **Methods:** A retrospective chart review was performed on all patients aged greater than 65 years old with a fragility hip fracture from October 2015 through June 2018. In addition to demographic and patient factors, we recorded time to surgery, type of surgical interventions performed, ability to ambulate in the post-operative period, 90-day post-operative complications and overall hospital cost. **Results:** There were 114 patients in the pre-Code Hip cohort and 132 patients in the post-Code Hip cohort. Demographic factors were not different between the 2 cohorts. Time from presentation to surgery in the post-Code Hip cohort was shorter at 23.1 ± 16.4 hours versus 33.2 ± 27.2 hours ($p < 0.001$). 30.3% of patients in the post-Code Hip cohort had at least one post-operative complication compared to 42.1% in the pre-Code Hip cohort (RR = 0.72, CI = 0.51 -1.01, $p = 0.05$). The post-Code Hip cohort had a significantly lower rate of hospital readmission ($p = 0.04$), unplanned reoperation ($p = 0.02$), surgical site infection ($p = 0.03$), and sepsis ($p = 0.05$). Total hospital cost per patient decreased from an average of \$14,079 +/- \$10,305 pre-Code Hip cohort to \$11,744 +/- \$4,174 per patient in the post-Code Hip cohort ($p = 0.02$). **Conclusions:** Implementation of our Code Hip protocol, which invokes a multidisciplinary approach to the elderly patient with a fragility hip fracture, is associated with shorter times from presentation to surgery, increased ability to ambulate post-operatively, decreased short term post-operative complication, and decreased hospital costs. **Level of Evidence:** Therapeutic Level III

Keywords

hip fracture, multidisciplinary care, healthcare costs, hip fracture outcomes

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Introduction

Geriatric hip fractures have long been associated with significant morbidity, with mortality rates as high as 30% at 1 year and 80% at 8 years.¹⁻³ In addition, hip fractures result in a substantial economic impact with a recent yearly estimate of 5.96 billion dollars to the United States healthcare system.⁴ With the rapid increase in the number of people entering the geriatric age group (>65 years old (y/o)) both the number of hip fractures, and the age at which they occur, have increased. By the year 2030, 20% of the United States (US) population will be considered elderly.⁵ In the US alone, there were approximately 258,000 hip fractures recorded in 2010.⁶

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These patients represent a complex and vulnerable group that typically present with many comorbidities and lower physiologic reserve. This has led to pre-operative assessments that can often delay surgical interventions, contributing to poor clinical outcomes.⁷ The goal is finding the balance between medical optimization and early surgical intervention. Due to the complexity of treating geriatric hip fractures, the American Academy of Orthopaedic Surgeons published clinical practice guidelines which include 25 diagnosis and treatment recommendations. From these recommendations a common theme emerged – that optimal care of geriatric hip fracture patients occur in the setting of a multidisciplinary team of providers with a patient-centered focus.⁶ This has been reinforced by other studies, indicating that instituting a multidisciplinary approach to hip fractures results in improved outcomes and faster time to surgery.⁸

Due to these recommendations, multiple protocols with variations of complexity have been published regarding perioperative care for hip fracture patients. Our institution implemented a “Code Hip” protocol in an attempt to improve outcomes of geriatric hip fractures. This is a simplified protocol when upon identification of a femoral neck, intertrochanteric, or subtrochanteric hip fracture in the emergency department, an operator sends out a page contacting family medicine, anesthesia and orthopaedic surgery to ensure early involvement of these 3 teams in the care of patients with hip fractures. The goal response time for each department is within one hour of receiving a Code Hip notification. The medicine team initiates the process of medical optimization and hospital admission. Orthopedics is consulted for orthogeriatric evaluation and surgical management. Anesthesia is consulted for pre-operative evaluation and surgical clearance with the goal of time to surgery less than 24 hours. A standard post-operative protocol includes rehabilitation therapy service consulted for assistance with post-operative mobilization and case management consulted for disposition planning. The purpose of this study was to evaluate the impact of the implementation of our Code Hip protocol on patient outcomes. We hypothesized that implementation of this protocol would decrease time from presentation to surgical intervention, and improve outcomes based on short term post-Operative data.

Materials and methods

Institutional Review Board approval was obtained, and a retrospective review was performed on all patients with a documented hip fracture (femoral neck, intertrochanteric, subtrochanteric) from October 2015 through June 2018 at our Level I trauma center. The Code Hip protocol was initiated in March 2017, and therefore we excluded all patients from March-June 2017 to allow for a grace period for adequate time to implement this protocol. Inclusion criteria included all ambulatory patients aged 65 y/o or greater, who had a low energy mechanism of injury (MOI), and underwent operative treatment. Patients were excluded for age under 65 y/o, high energy mechanism, non-ambulatory status at baseline, or non-operative treatment.

Inpatient and outpatient medical records were reviewed to obtain demographic data, medical comorbidities, concurrent injuries, MOI, body-mass index (BMI), preoperative level of function (e.g. community ambulatory, use of assistive device, wheelchair-dependent, etc.), and length of hospitalization. Imaging and charts were reviewed to determine fracture type, laterality, and if the fracture was open or closed. Surgical data was extracted to include type of surgery including: arthroplasty, cephalomedullary nail (CMN), sliding hip screw (SHS), or closed reduction with percutaneous screw fixation (CRPS). Post-operative mobility data was extracted from physical therapy (PT) notes including timing and type of initial transfer, maximum transfer obtained during the hospital stay, distance and timing to first ambulation, and maximum distance ambulated during the inpatient stay. Ninety-day complications were recorded. Medical complications included renal (acute renal failure or acute kidney injury), genito-urinary (urinary tract infections (UTI), urinary retention), gastro-intestinal (bowel obstruction, ileus), cardiac (cardiac arrest, myocardial infarction (MI), dysrhythmia), venous thromboembolic (deep venous thrombosis (DVT), pulmonary embolism (PE)), stroke, sepsis, clostridium difficile diarrhea, pulmonary (pneumonia, respiratory distress), decubitus ulcer formation, intensive care unit (ICU) admission, and unplanned readmission. Surgical complications included hip dislocation/instability, failure of implants, surgical site infections, and unplanned secondary or revision procedures. Disposition at discharge was also recorded. A third party source is used at our institution to track costs and outcomes associated with hip fracture patients. Their cost data was utilized to calculate the difference in total hospital cost minus implant cost between the pre-Code Hip cohorts and post-Code Hip cohorts.

Statistical analysis was performed on the pre-Code Hip cohort and post-Code Hip cohort to include differences in group demographics, time from presentation to surgery, complication rates, hospital length of stay, and postoperative mobilization. Continuous variables were analyzed for normality using the Shapiro-Wilks and Anderson Darling tests. Normally distributed data was compared using Student t-tests or Welch’s t-test, otherwise Mann Whitney U tests were used when appropriate. Categorical variables were analyzed using Fisher exact tests or Pearson’s Chi-square tests. Relative risks (RR) and 95% confidence intervals (CI) for complications were calculated. Data analysis was conducted using Microsoft Excel (Microsoft, Redmond, WA), GraphPad (Graphpad Software, La Jolla, CA), and R 3.4.3 (R Foundation for Statistical Computing, Vienna, Austria). Statistical significance was set at $\alpha = 0.05$.

Results

Two hundred forty-six patients were included in the final data analysis with an average age of 81.2 ± 8.2 years. Sixty-eight percent were females. There was one open fracture in a patient with a low energy mechanism of injury that otherwise met inclusion criteria and therefore was included in the study.

Table 1. Injury Characteristics.

Pre-code hip (n = 114)	Post-code hip (n = 132)	P-value	
Peritrochanteric	79	82	0.596
Femoral Neck	35	50	
Type of Surgery			0.766
Cephalomedullary nail	77	82	
Dynamic Hip Screw	2	2	
Arthroplasty	30	43	
Percutaneous Fixation	5	5	

Baseline level of function included 181 patients who were community ambulators without assistive devices and 65 who ambulated with a cane or walker. Thirteen patients in the pre-Code Hip cohort and 12 patients in the post-Code Hip cohort had concomitant injuries. These injuries included various other fragility fractures (distal radius/ulna, proximal humerus, vertebral compression, rib, pelvis/acetabulum) as well as head trauma (subdural hematoma, subarachnoid hemorrhage, subgaleal hematoma, facial fracture). There were 85 femoral neck, 150 intertrochanteric and 11 subtrochanteric fractures. Fixation included 159 CMNs, 73 arthroplasties, 10 CRPS fixations, and 4 SHSs (Table 1).

There were 114 patients in the pre-Code Hip cohort and 132 patients in the post-Code Hip cohort. Both groups were similar in age, BMI, preoperative comorbidities, gender, fracture classification, method of fixation, and preoperative level of function ($p > 0.05$). Group demographics are summarized in Table 2. Time to surgery (TTS) was significantly shorter in the post-Code Hip cohort at 23.1 ± 16.4 hours versus 33.2 ± 27.2 hours in the pre-Code Hip cohort ($p < 0.001$) (Table 3). The median TTS was also statistically shorter at 19.3 hours [IQR 13.9-26.8] in the post-Code Hip cohort and 24.2 hours [IQR 19.7-42.7] in the pre-Code Hip cohort ($p < 0.001$). There were 7 outliers (with an outlier defined as TTS > 72 hours) in the pre-Code Hip cohort and one outlier in the post-Code Hip Cohort. When excluding these outliers, the mean TTS for the post-Code Hip cohort was 22.5 ± 13.7 hours and 27.8 ± 13.9 hours for the pre-Code Hip cohort ($p < 0.004$). In the post-Code Hip cohort 75.8% of patients were able to ambulate a distance of greater than 5 feet within 72 hours of surgery compared to 60.5% in the pre-Code Hip cohort ($p = 0.01$). Disposition at discharge was not significantly different between the 2 groups.

Overall, 88 patients (35.8%) had at least one complication. The post-Code Hip cohort had a statistically significant lower overall complication rate at 30% compared to 42% in the pre-Code Hip cohort ($p = 0.05$). The post-Code Hip cohort also had lower rates of readmissions ($p = 0.05$), secondary procedures ($p = 0.008$), sepsis ($p = 0.03$) and surgical site infections ($p = 0.02$) (Table 4). While not statistically significant, the median hospital length of stay decreased from 6 days [IQR 4.0-7.0] in the pre-Code Hip cohort to 5.0 days [IQR 4.0-7.0] in the post-Code Hip cohort (Table 3). Total hospital cost per case decreased from an average of \$14,079 +/- \$10,305 per patient in the pre-Code Hip cohort to \$11,744 +/- \$4,174 per patient in

Table 2. Patient Demographic Characteristics.

	Pre-“Code Hip” (n = 114)	Post-“Code Hip” (n = 132)	P-value
Age in years			
Mean (SD)	81.6 ± 8.3	80.8 ± 8.1	0.341
Body Mass Index			
Mean (SD)	25.4 ± 4.9	25.4 ± 4.4	0.962
Sex			
Male	39	40	0.584
Female	75	92	
Number of comorbidities			
Diabetes Mellitus	37	46	0.611
Cardiovascular	140	173	
Psychiatric	28	53	
Neurological	5	7	
Renal	9	19	
Respiratory	1	5	
Malignancy	8	16	
Anemia	9	11	
GI	11	17	

the post-Code Hip cohort leading to a total hospital cost savings of approximately \$2,335 per patient, or \$308,220 over the study period ($p = 0.02$, 95% CI 408.65-4262.41).

Discussion

The results of this study demonstrate that implementation of the Code Hip protocol was associated with a decreased time from presentation to surgery, increased ability to mobilize in the early post-operative period, lower overall rate of complications, and decreased overall hospital costs. While other studies have evaluated the effects of streamlined multidisciplinary care for elderly, hip fracture patients,⁹⁻¹³ this study is the first to introduce this simple but effective model of care, and demonstrate the associated lower rate of complications and decreased hospital costs. Our protocol involving a “Code hip” page were able to engage 3 critical teams, orthopaedic surgery, anesthesia and medicine in the care of patients with hip fractures. Our standard post-operative care for patients remained the same.

Many recent studies have looked into the effects of a multidisciplinary approach on the care and outcomes of geriatric patients with hip fractures. In a recent systematic review, Patel et al concluded that a coordinated multidisciplinary orthogeriatric care model has a significant potential for decreasing time from presentation to surgery and improving patient outcomes while at the same time paving a way for healthcare cost savings, but that further study was needed to define the ideal model.¹⁴ Although the ideal model for a multidisciplinary approach has not been defined, our hospital was able to improve outcomes for these patients with a relatively short implementation period of approximately 3 months in our county hospital in West Texas. This was a simple and effective model as the majority of change from prior procedure focused

Table 3. Length of Stay and Time from Presentation to Surgery.

Groups	Pre-“Code Hip”	Post-“Code Hip”	P-value
Length of Hospital stay (days) Median [IQR]	6.0 [4.0-7.0]	5.0 [4.0-7.0]	0.892
Time to surgery (hours) Average [SD]	33.2 ± 27.2	23.1 ± 16.4	<0.0004
Hospital Cost Average [SD]	\$14 079 ± 10 305	\$11 744 ± 4174	0.02

Table 4. Outcomes and Complications.

	Pre	Post	P-value	Relative Risk*	95% CI
Patients with ≥ 1 complication	48 (42%)	40 (30%)	0.05	RR = 0.72	(0.51 – 1.01)
Patients without complications	66 (58%)	92 (70%)			
Select complications					
Readmission	20	12	0.05	RR = 0.52	(0.27, 1.01)
Secondary Procedures	10	2	0.008	RR = 0.17	(0.04, 0.77)
Sepsis	8	2	0.03	RR = 0.22	(0.05, 1.00)
Surgical site infections	9	2	0.02	RR = 0.19	(0.04, 0.87)

on effective early multidisciplinary communication with the goal of early operative fixation.

Several studies have looked at the cost-saving advantage of the cooperative management between the different specialists for the treatment of the hip fractures.⁹⁻¹³ The determination of costs is a challenging. It includes multiple different facets of treatment, and the method of cost analysis estimation has been described in multiple ways throughout the literature. Swart et al conducted an economic analysis of osteoporotic hip fractures. They found that the multidisciplinary comanagement approach was more cost effective than a non-comanagement approach.¹² These findings were also seen in our Code Hip cohort. We analyzed the cost difference by the calculation of the average net hospital cost minus implant cost of each patient for both the pre-Code Hip cohort and the Code Hip cohort. Our cost data was acquired through a third-party source which tracks this data for the institution. The results of the analysis showed a reduction of the total hospital cost from an average of \$14,079 per patient in the pre-Code Hip cohort to \$11,744 per patient in the Code Hip cohort. Extrapolated to the 132 patients in the Code Hip cohort, this was calculated to result in a total hospital cost savings of approximately \$308,220, or \$2,335 per patient, over the study period. Importantly, this underestimates the true cost savings associated with the “Code Hip” protocol as there would be additional cost savings based on the decreased rate of post-operative complications in the Code Hip cohort.

Geriatric hip fracture patients represent a complicated patient population, typically with a significant amount of concurrent medical comorbidities requiring optimization prior to surgical intervention. Several studies have reported on the outcomes associated with medical optimization prior to hip

fracture surgery.¹⁵⁻¹⁷ From these studies, recommendations have been made for correcting abnormalities such as: blood glucose levels, pre-operative anemia, creatinine levels associated with acute, chronic or acute on chronic kidney disease, respiratory capacity, etc. Further workup may be necessary for high-risk cardiac conditions including unstable coronary syndromes, decompensated heart failure, significant arrhythmias, and severe valvular disease. Otherwise, hip fracture surgery is generally not delayed for additional diagnostic testing. In our Code Hip protocol, both family medicine and anesthesia are involved in the pre-operative evaluation process to determine the fitness for operative intervention. While the goals of optimization did not change between the two cohorts, we felt that the coordination between these two departments could help streamline the medical optimization process as well as decrease the amount of unnecessary diagnostic tests being performed pre-operatively. The authors believe that the management of this type of fracture in this patient population needs a balance between the optimization of the active medical conditions and facilitating surgical intervention.

The timing from presentation to surgery has been discussed by many authors, and several studies have concluded that a delay in timing of surgery increases the morbidity and mortality for hip fracture patients.¹⁸⁻²⁰ In our study we found that implementation of the Code Hip protocol was associated with a statistically shorter average and median time from presentation to surgery, both when outliers (patients with TTS > 72 hours) were included and excluded. There were 7 outliers in the pre-Code Hip cohort and one outlier in the post-Code Hip cohort. The decrease in outliers in the post-Code Hip cohort may represent an improved ability to medically optimize

patients in a timely manner, and avoid unnecessary additional diagnostic testing. As all other variables associated with the patient's care remained the same during the time period of this study, the decrease in time from presentation to surgery can be directly attributed to the implementation of this multidisciplinary program, and the emphasis on fast-track surgery. In addition, our results showed a decrease in the overall rate of short-term complications, as well as decreases in certain complications including surgical site infection and sepsis.

Bentler et al²¹ previously compared the change in functional status that results from sustaining a hip fracture. They noted that, compared to the standard population, patients with a geriatric hip fracture demonstrated a functional decline generally 3 times faster than those of the control population. Prior studies have demonstrated the role that post-operative mobilization has on patient outcomes, such as that the inability to mobilize is associated with increased rates of pneumonia and hospital length of stay,²² and is a key measure in the ability to recover functional independence and the patient's prior level of function.²³⁻²⁹ Previous data from our institution demonstrated that ambulating greater than 5 feet within 72 hours was associated with a significantly decreased rate of post-operative morbidity and mortality.³⁰ In this study we found that 75.8% of patients in the post-Code Hip cohort were able to achieve this ambulation threshold, whereas only 60.5% in the pre-Code Hip cohort were able to do so.

Limitations to this study include that it is a retrospective review, and therefore the quality of the data reported is directly linked to the quality of the available documentation. In addition, the available cost data supplied by a third party provided hospital costs per patient, but did not itemize those costs further. We also reported only short term outcomes up to 90 days from surgery, and therefore our data cannot be extrapolated to longer-term measures. Also, this study was performed at a single institution, and therefore the data may not be able to be generalizable to other locations.

The geriatric hip fracture population is a complex patient population with the need for both medical and surgical evaluation and treatment. The implementation of the Code Hip protocol at our facility streamlined the multidisciplinary approach for treatment throughout the duration of pre-operative and post-operative care. This resulted in a decrease in time from presentation to surgery, short-term complications and net hospital costs.

Authors' Note

Michael S. Reich is now affiliated with Department of Orthopaedic Surgery, Regions Hospital, St. Paul, MN, USA.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.


Ethical Approval

The study design was approved by the ethics review board (IRB approved).

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