fortune Journals

Research Article

JOURNAL OF SURGERY AND RESEARCH

ISSN: 2640-1002

Emergency Department Management of Hip Fractures: Factors Predicting Readmission at 30 day, 60 day, 90 day and 1 year Intervals

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Abstract

Introduction: The incidence of hip fractures is increasing and will have increased to 6.3 million in 2050. Concurrently, emergency departments have been experiencing overcrowding. The purpose of the present study is to determine if a series of factors affected readmissions at 30 day, 60 day, 90 day, and 1 year intervals in hip fracture patients at five different hospital locations. The factors analyzed included: Number of hours between completion of triage care and entry into the operating room, the time of day the patient entered the operating room, the day of week the patient was discharged from hospital, ASA score, discharge disposition, and length of stay.

Methods: This was a retrospective study of patients with an admission from the Emergency Department to the Operating room for a hip or femoral fracture between January of 2018 and December of 2020. Patients were identified using a series of reports in Epic and HPM which listed the time the patient went to the operating room following completion of triage care, length of stay, and discharge disposition. Readmissions were counted at 30 days, 60 days, 90 days, and 1 year following discharge. Chi-square tests were performed to determine statistical significance and a p-value of <0.05 was deemed to be statistically significant.

Results: A total of 2308 patients were diagnosed with hip fractures who presented to the Emergency department to Atlantic Health System hospitals. Our findings indicated that being transferred to the operating room after 12 hours following completion of triage care does appear to have a statistically significant effect on 30 day readmissions ($p=0.005$) and entering the operating room after 24 hours does effect 90 day readmissions ($p=0.014$). Additionally, there was a significantly higher rate of readmission in patients who were discharged to a facility instead of home at all intervals. Further, higher ASA scores had a significant effect on readmissions at varying intervals.

Conclusion: A number of complications can arise from delayed management of hip fractures. The findings of our study suggest that emergency department medical teams as well as orthopedic teams should consider the pitfalls of delaying operative management of hip fractures.

Introduction

Hip fractures pose a significant burden in the elderly population. Risks factors associated with hip fractures include: age, gender, osteoporosis, thyroid disorders, intestinal disorders, medications, calcium and vitamin D deficiency, physical inactivity as well as tobacco and alcohol use [1-5]. Concurrently, complications involving hip fractures are avascular necrosis

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Citation: Brian Begley, Francis Maguire, Tyler Hoskins, Justin M Miller, James C Wittig. Emergency Department Management of Hip Fractures: Factors Predicting Readmission at 30 day, 60 day, 90 day and 1 year Intervals. Journal of Surgery and Research. 6 (2023): 195-201.

Received: February 16, 2023
Accepted: February 23, 2023
Published: May 19, 2023

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DOI:10.26502/jsr.10020295

of the femoral head, prolonged immobilization leading to pulmonary embolism and pneumonia, as well as prolonged hypercoagulable inflammation leading to stroke and myocardial infarction [6-10].

Additionally, the incidence of hip fractures is rising. It has been estimated that the global number of hip fractures will have increased from 1.6 million in 2000 to 6.3 million in 2050 [11,12]. This rise in the total number of fractures corresponds with the increasing age of the population as well as the increased incidence of hip fractures in the elderly [13-15]. As the total number of hip fractures increases alongside a growing elderly population, the total cost of incident fractures is projected to increase from $209 billion during 2006-2015 to $228 billion for 2016-2025 with the largest changes predicted for hip fractures, where incidence will increase by 56% and costs will rise by 60% [16].

At the same time, the emergency department has been experiencing overcrowding. This has been described in the literature as a patient safety issue and public health problem [17,18]. Crowding can occur due to volume of patients, delays in accessing or treating patients, or impediments in patients leaving [18,19]. Specifically, these factors could lead to a delay in the time to surgery for patients with hip fractures. Risk factors that are associated with increased time to surgery include unavailability of operating room or surgical staff, stabilizing the patient's current condition, completing the medical evaluation and waiting for laboratory results [20-22]. Moreover, many studies documented in the literature have shown that the amount of time spent in the emergency department increases morbidity and mortality of patients with hip fractures [23-26].

The Atlantic Health System is responsible for musculoskeletal care at five different locations in the New Jersey area (Morristown, Chilton, Hackettstown, Newton, Overlook) and provides services in a range of health care systems. The purpose of the present study is to determine if a series of factors affected readmissions at 30 day, 60 day, 90 day, and 1 year intervals in hip fracture patients. The factors analyzed included: Number of hours between completion of triage care and entry into the operating room, the time of day the patient entered the operating room, the day of week the patient was discharged from hospital, ASA score, discharge disposition, and length of stay.

Methods

This was a retrospective study of patients with an admission from the Emergency Department to the Operating room for a hip or femoral fracture between January of 2018 and December of 2020. Patients were identified using a series of reports in Epic and HPM which listed the time the patient went to the operating room following completion of triage care, length of stay, and discharge disposition. Inclusion criteria were patients over the age of 18 years old, had a hip fracture diagnosed with radiographic imaging by an orthopedic surgeon, and operative repair of the fracture. Exclusion criteria were patients under the age 18. The reports were then imported into a Microsoft Access database, where they were combined using a series of queries that matched patients from each report by Hospital Account Record. Further queries were written to identify how much time passed between completion of triage care and entry into the OR, what times of day the patients went into the OR, as well as discharge disposition and the day of week the patient was discharged. A series of queries were also written to identify if patients were readmitted following their discharge from the hospital. Readmissions were counted at 30 days, 60 days, 90 days, and 1 year following discharge by matching separate admissions with patient MRNs. After the queries were completed, the results were exported into a Microsoft Excel spreadsheet where the data was sorted into a series of pivot tables. The data was then analyzed statistically using Minitab. Chi-square tests were performed to determine statistical significance and a p-value of $<.05$ was deemed to be statistically significant.

Results

Between January of 2018 and December of 2020, a total of 2308 patients were diagnosed with hip fractures who presented to the Emergency department to Atlantic Health System hospitals at Morristown, Chilton, Hackettstown, Newton or Overlook. There were 627 males (27%) and 1683 females (73%). The average age of the patient was 80 years old. The average time it took for patients to go from triage to the operating room was 31 hours. The average BMI of the patients was 24.7.

We subdivided the patients to examine the rate of readmission within one year based on the hours spent in triage care in the emergency department before entering the operating room as seen in table 1. Of patients that entered the operating room with less than 12 hours spent in triage, there was no significant difference in 30 day, 60 day, 90 day, or 1 year readmission rate (p=0.687 vs 0.546 vs 0.311 vs 0.96). Analysis of patients that were admitted to the operating room after 12 to 24 hours of triage found there to be a significant difference for 30 day readmission rates (2.4%) compared to 60 day, 90 day and 1 year readmission rates (p=0.019 vs 0.83 vs .333 vs 0.068.) For those patients who were in triage for 24 to 36 hours, there was a significant difference in the rate of readmissions at 30 day (p=<0.001), 90 day (p=0.014) and 1 year (p=0.044) readmission rates compared to 60 day (p=0.171) readmission rate. Patients who were in triage for 36 to 48 hours before being sent to the operating room similarly showed a significant difference in readmission rates at the 30 day (p=<0.001), 90 day (p=0.001) and 1 year (p=0.031) mark compared to 60 days (p=0.129). Further, triage times of 48 to

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72 hours demonstrated statistically significant difference in readmission rates at the 30 day (p=0.008) and 90 day (0.003) marks opposed to the 60 day(p=0.258) and 1 year (p=0.283) marks. Triage of greater than 72 hours similarly showed statistical significance for readmission at 30 days (p=0.007) and 90 days (p=0.003) compared to 60 days(p=0.245) and 1 year (p=0.399).

Analysis that analyzed the time of day to determine if this factor had an effect on the rate of readmission for those who presented to the emergency department with hip fractures. As shown in table 2, the time of day the patient entered the operating room following completion of triage care did not have any significant effect on the readmission rates at the 30 day (p=0.759), 60 day (0.977), 90 day (0.433) or 1 year (p=0.288) dates. The rate of readmission for patients who were discharged to home versus a facility was then compared. As demonstrated in table 3, those who were discharged to a facility instead of home had a statistically significant higher rate of readmission at the 30 day (p=0.016), 60 day (p=0.030) and 1 year marks (p=<0.001).

The patient's ASA score was then analyzed to determine the effect on readmission at the 30 day, 60 day, 90 day and 1 year mark as indicated in table 4. For patients with an ASA score 1, there was significance in the 1 year admission mark (p=0.017). Those with an ASA score at 2 had significance at every interval (p=0.009 vs 0.006 vs <0.001) except 90 days(p=0.083). ASA scores of 3 had significance at the 1 year mark only (p=<0.001) whereas an ASA of 4 demonstrated significant effects at the 30 day(p=<0.001) and 60 day (p=<0.007) interval. Analysis was then turned to determine if the discharge day of the week affected readmission rates. Overall, it was shown that the day of the week the patient was discharged from the hospital did not appear to have any significant effect on readmissions at the 30 day, 60 day, 90 day or 1 year interval as shown in table 5. An odds ratio was then completed analyzing post-operative length of stay on readmission in hip fracture patients and determined statistical significance at the 30 day(p=0.001) and 1 year intervals(p=0.021) as evident in table 6.

Discussion

Concurrently, the incidence of hip fractures is increasing while the emergency department experiences overcrowding. The greater number of people in triage confounds the ability of patients presenting to the emergency department to get to the operating room in a timely manner. The risk factors associated with delayed time to surgery for hip fractures has been well documented as well as those associated with readmission rates following hip fracture repair. Yet, very few studies have examined whether the rates of readmission are associated with triage care and discharge status. The outcomes of this retrospective review suggest that being transferred to the operating room after 12 hours following completion of triage care does appear to have a statistically significant effect on increasing 30 day readmissions rates; entering the operating room after 24 hours of triage care is associated with higher 90 day and 1 year readmissions rates; there was a significantly higher rate of readmission for those discharged to a facility instead of home and ASA scores had a significant effect on readmission rates at varying intervals.

Table 1: Rate of readmission within one year among hip fracture patients who entered the or within certain hours of completion of triage care 2018-2020

Number of Hours	30-Day Readmission	30-Day Readmission Rate	60-Day Readmission	60-Day Readmission Rate	90-Day Readmission	90-Day Readmission Rate	1 Year Readmission	1 Year Readmission Rate
≤12	19	0.82%	11	1.30%	7	1.60%	38	3.25%
p-value	0.687		0.546		0.311		0.96	
Dec-24	61	2.64%	49	4.77%	33	6.20%	123	11.53%
p-value	0.019		0.83		0.333		0.068	
24-36	41	1.78%	24	2.82%	19	3.64%	88	7.45%
p-value	0		0.171		0.014		0.044	
36-48	27	1.17%	15	1.82%	10	2.25%	46	4.25%
p-value	0		0.129		0.001		0.031	
48-72	32	1.39%	16	2.08%	14	2.69%	50	4.85%
p-value	0.008		0.258		0.003		0.283	
>72	17	0.74%	9	1.13%	12	1.65%	20	2.51%
p-value	0.007		0.245		0.003		0.399	
Chi-Square Analysis p-value:	0.005		0.354		0.014		0.291	

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DOI:10.26502/jsr.10020295

Table 2: Rate of readmission within one year among hip fracture patients who entered the or within certain times of day of completion of triage care 2018-2020

Times of Day	30-Day Readmission	30-Day Readmission Rate	60-Day Readmission	60-Day Readmission Rate	90-Day Readmission	90-Day Readmission Rate	1 Year Readmission	1 Year Readmission Rate
12M to 8AM	7	0.30%	5	0.52%	5	0.74%	13	1.30%
p-value	0.555		0.847		0.666		0.407	
8AM to 12N	34	1.47%	25	2.56%	18	3.34%	65	6.15%
p-value	0.616		0.643		0.927		0.677	
12N to 4PM	76	3.29%	49	5.42%	37	7.02%	161	13.99%
p-value	0.529		0.785		0.725		0.147	
4PM to 8PM	68	2.95%	39	4.64%	33	6.07%	100	10.40%
p-value	0.216		0.839		0.375		0.144	
8PM to 12M	12	0.52%	6	0.78%	2	0.87%	26	1.99%
p-value	0.814		0.664		0.121		0.208	
Chi-Square Analysis p-value:	0.759		0.977		0.433		0.288	

Table 3: Rate of readmission within one year among hip fracture patients by discharge status (Home vs Facility(2018-2020)

Times of Day	30-Day Readmission	30-Day Readmission Rate	60-Day Readmission	60-Day Readmission Rate	90-Day Readmission	90-Day Readmission Rate	1 Year Readmission	1 Year Readmission Rate
12M to 8AM	7	0.30%	5	0.52%	5	0.74%	13	1.30%
p-value	0.555		0.847		0.666		0.407	
8AM to 12N	34	1.47%	25	2.56%	18	3.34%	65	6.15%
p-value	0.616		0.643		0.927		0.677	
12N to 4PM	76	3.29%	49	5.42%	37	7.02%	161	13.99%
p-value	0.529		0.785		0.725		0.147	
4PM to 8PM	68	2.95%	39	4.64%	33	6.07%	100	10.40%
p-value	0.216		0.839		0.375		0.144	
8PM to 12M	12	0.52%	6	0.78%	2	0.87%	26	1.99%
p-value	0.814		0.664		0.121		0.208	
Chi-Square Analysis p-value:	0.759		0.977		0.433		0.288	

Table 4: Rate of readmission within one year among hip fracture patients by ASA Score 2018-2020

Discharge Status	30-Day Readmission	30-Day Readmission Rate	60-Day Readmission	60-Day Readmission Rate	90-Day Readmission	90-Day Readmission Rate	1 Year Readmission	1 Year Readmission Rate
Facility	181	7.84%	115	12.82%	82	16.38%	336	30.94%
Home	16	0.69%	9	1.08%	13	1.65%	29	2.90%
Chi-Square Analysis p-value:	0.016		0.03		0.978		0	

Similarly to the findings of our study, the literature has shown that delays to the operating room following hip fracture can lead to increased morbidity and mortality which can result in readmission. A recent study by Paul et al. demonstrated that delays in hip fracture surgery increases in-hospital mortality risk. The study examined 144 patients who met the inclusion criteria and the results showed that delayed surgery of more than 48 hours was associated with higher in-hospital mortality risk. This finding was statistically significant and the odds ratio demonstrated an 8-fold increased risk [27]. Similarly, Pincus et al published a study in 2017 that concluded adults undergoing hip fracture surgery, increased wait time, were

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associated with a greater risk of 30-day mortality and other complications. Compared with 13, 731 propensity-score matched patients who received surgery earlier, patients who received surgery after 24 hours had a significantly higher risk of 30-day mortality (898 [6.5%] vs 790 [5.8%] with a percent absolute risk difference of 0.79 [28]. Videl et al also published a study that demonstrated increased mortality from time of fracture to hospital admission and surgery. The results of his study revealed increased time from fracture to hospital admission was associated with reduced survival to hospital discharge with a hazard ratio of 1.09 where p = 0.005 [29].

Conversely, several studies have shown that there is no relation between timing of surgery and morbidity and mortality following hip fractures. Greve et al conducted a nationwide cohort study of 59,675 patients undergoing hip fracture surgery between January 1, 2013 and December 31, 2017 with a 4-month follow-up of mortality. They interpreted that there was no association between waiting time to surgery and mortality for healthier patients with hip fracture [30]. Khan et al also published systematic review that did not find a statistically significant relation between timing of surgery and mortality [31]. Further, Hongisto et al demonstrated a weak association between mortality and waiting times following hip fracture [32].

Additionally, risk factors for readmission following hip fracture surgery have been well documented in the literature. Ali et al conducted a systematic review for risk factors associated with 30-day hospital readmission after hip fracture. Twenty-Two studies met inclusion criteria and the results demonstrated age, co-morbidities and functional status were strong risk factors associated with readmission [33]. A recent study published by Checketts et al examined 33,740 unique patients and concluded patients with higher Charlson co-morbidity index values, those dis-charged to facilities other than their home, those with delicate fluid/electrolyte status, and those with previous hospitalizations in the year before hip fracture presentation should be monitored closely because they are at increased risk of hospital readmission [34]. Martin et al. contributed similar findings to literature by concluding 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 [35].

Emergency department crowding is a major global healthcare issue. The findings of our study, that longer triage time before admittance to the operating room leading to increased readmission rates, could be explained by this finding. It has been suggested that inadequate care in the

Table 5: Rate of readmission within one year among hip fracture patients by discharge day of the week 2018-2020

ASA Score	30-Day Readmission	30-Day Readmission Rate	60-Day Readmission	60-Day Readmission Rate	90-Day Readmission	90-Day Readmission Rate	1 Year Readmission	1 Year Readmission Rate
1	3	0.13%	0	0.13%	1	0.17%	0	0.17%
p-value	0.773		0.189		0.828		0.017	
2	37	1.60%	20	2.47%	18	3.25%	56	5.68%
p-value	0.009		0.006		0.083		0	
3	122	5.29%	83	8.88%	66	11.74%	264	23.18%
p-value	0.951		0.257		0.132		0	
4	35	1.52%	21	2.43%	10	2.86%	45	4.81%
p-value	0		0.007		0.841		0.094	
Chi-Square Analysis p-value:	0		0.003		0.37		0	

Table 6: Odds ratio for post -operative length of stay on readmission in hip fracture patients 2018-2020

	Row Labels	Average of Post-Op LOS	Odds Ratio	Chi-Square Analysis p-value
30 Days	No Readmit	4	1.0776	0.001
	Readmit	4.8		
60 Days	No Readmit	4.1	1.025	0.423
	Readmit	4.3		
90 Days	No Readmit	4	1.0501	1.116
	Readmit	4.5		
1 Year	No Readmit	4	1.0447	0.021
	Readmit	4.4		

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emergency department due to overcrowding might increase the probability of being readmitted [36]. Asplin et al recognized this concern as a major barrier to patient receiving timely care and issued a "call to arms" to researchers and policymakers to address the problems [37]. Vicello et al proposed four major areas that could decrease emergency department crowding which included: smoothing of elective admissions, early discharge, weekend discharge and full capacity plans [38]. It remains to be seen if these proposes could improve triage time for patients with hip fracture, but decreasing the amount of patients in the emergency department could expedite the process of surgical intervention for hip fractures.

The authors acknowledge the present study has several limitations. As a retrospective review of patient records, it includes all inherent biases associated with retrospective studies. Each surgeon was allowed to decide whether to perform an internal fixation, hip hemiarthroplasty or total hip arthroplasty at their discretion. This preference was influenced by the patient's preoperative findings as well as surgeon training. The variation in treatment strategy could lead to differences in readmission rates. Additionally, stem design was not accounted for. The study did not take into consideration reasons for delays in triage in the emergency department. Similarly, we acknowledge that the findings of this study may not be applicable to other emergency departments or orthopedic teams. Despite the present limitations, we believe our findings can contribute to the literature of readmission rates for hip fracture patients.

Conclusion

Emergency department crowding is posing a significant burden on healthcare systems and can be associated with delays in patient care. Specifically, for patients requiring surgery, these delays can result in significant consequences relating to the patient's morbidity, mortality as well as readmission rates following surgery. Among patients that presented to the emergency department with hip fractures at the Atlantic Health System, patients that were transferred to the operating room after 12 hours following completion of triage care had a statistically significant effect on 30 day readmission rates. Additionally, there was a significantly higher rate of readmission in patients who were discharged to a facility instead of home. These findings suggest that United States emergency department physicians and orthopedic surgeons should consider the risk of delaying surgery for hip fracture patients. Future studies considering triage time to surgery should take into account the various causes for delays to surgery as well as specific patient characteristics and comorbidities. Further studies in the United States may require large, registry based efforts to reveal small effect sizes

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