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Original article

Factors Associated with Missed Hip Fractures

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Abstract

Accurate diagnosis and timely care is critical in the treatment of hip fractures in the elderly. Missed or occult hip fractures can be the source of significant morbidity. The purpose of this study was to identify factors associated with an hip fracture that was missed upon a patient's initial presentation. A retrospective chart review of patients aged 55-100 who presented to a large, academic medical center that acts as a tertiary referral center between January 1, 2015 and October 1, 2018 with a femoral neck or intertrochanteric (IT) hip fracture was performed. An injury qualified as a "missed fracture" if the patient was seen by a provider initially for hip or knee pain but was not initially diagnosed with a hip fracture or presented to our institution for evaluation following unsatisfactory resolution of symptoms elsewhere. A total of 720 patients presented to our medical center with a femoral neck (343) or IT (377) hip fracture between January 1, 2015 and October 1, 2018. Of those patients, 20 (2.9%) were initially "missed", 15 of which were femoral neck fractures and 5 were IT fractures. Analysis comparing the two groups demonstrated that "missed fracture" types were more likely to be femoral neck fractures (p=0.013), have a baseline altered mental status (p=0.003), be ambulatory to some degree following symptom onset (p<0.001), and report no fall trauma prior symptom onset (p<0.001). No difference was found in rates of complications or mortality. The diagnosis of hip fracture in certain patient populations presenting with complaints of hip or knee pain, with or without a known fall regardless of ambulatory ability should always be considered, especially in the cognitively impaired so that delays in diagnosis and treatment can be avoided. All providers in the chain of care, including ED, primary care, orthopedic, and radiology, need to have a high index of suspicion in these patients in order to ensure that hip fractures are diagnosed in a timely manner.

Keywords: ***Orthopedics, trauma, hip fracture, missed fracture, missed diagnosis***

Introduction

Hip fractures are a common injury in the elderly population, with over 300,00 hip fractures estimated to occur in the United States alone and over 90% occurring in patients older than 60 years [1]. They represent a major concern for the healthcare system, both in terms of cost and in terms of morbidity and mortality [2,3]. The one-year mortality for patients who sustain hip fractures has been reported to range from 14%-36% [4,5,6]. It has been shown that delay to surgery for hip fractures, particularly more than 48 hours, significantly increases both inpatient and one-year mortality [7,8]. Therefore a prompt diagnosis is critical in the care of these patients. It is also important for providers within the healthcare system to be able to accurately diagnose and refer hip fractures so that there is system-wide quality of care for the patients that sustain these fractures.

Diagnosis of a hip fracture is usually accomplished with a directed physical, plain radiographs and sometimes advanced imaging. Despite this, providers still miss the diagnosis of a hip fracture for various reasons including: lack of clinical suspicion, poor physical exam, inadequate experience or failure to obtain proper imaging. The purpose of this study was to identify factors associated with failure to identify patients who presented with a missed or occult hip fracture.

Methods

This study included patients selected from a series of consecutive patients 55-100 years old who presented to a large, academic medical center with both a functioning Emergency Department and a tertiary orthopedic referral center, with a femoral neck (FN) or intertrochanteric (IT) hip fracture between January 1, 2015 and October 1, 2018. A retrospective chart review to identify all hip fracture patients was performed. An injury qualified as a "missed fracture" if the patient was initially seen by a provider for symptoms of hip or knee pain but was not diagnosed with a hip fracture, was not given referral for follow-up, or presented to our institution for evaluation following unsatisfactory resolution of symptoms elsewhere. In each case, the diagnosis of a hip fracture was confirmed radiographically. Age, sex, and Charlson comorbidity index (CCI) were collected as demographic data. The specific clinical details collected for each patient in this cohort included: who the patient saw for their initial visit, time between symptom onset and diagnosis, report of a fall or incident trauma,

ambulatory status following symptom onset, presence of hip or knee pain, baseline physical deficits, baseline mental status deficits, and imaging modalities used, including whether or not imaging was done. "Baseline physical deficits" included patients with hemiplegia, were bedbound, or had otherwise altered baseline ambulatory status. "Baseline mental status deficits" included diagnosed dementia, developmental delay, and any other baseline condition that would affect the patient's ability to communicate their symptoms and history at baseline. The fracture pattern of each patient was classified according to 2018 AO/OTA Fracture and Dislocation Classification Compendium. Patient demographic and medical comorbidities were collected. Patient and injury characteristics and outcomes were compared between the identified and missed hip fracture groups. Those presenting with an "Atypical Femoral Fracture" were excluded.

Statistics were analyzed using IBM SPSS Version 25 (Armonk, NY: IBM Corporation). Significance was set at $p < 0.05$ for all analyses. Independent samples t-tests were used to assess differences between continuous variables while Fisher's exact tests and chi-squared analyses were used for categorical variables as appropriate. All independent samples tests were also tested for variance with equality of variance.

Results

A total of 720 patients presented to our medical center with either a FN or IT hip fracture during the time period studied. Of these patients, 20 (2.9%) were initially "missed" (MH). A summary of demographic data for both groups is presented in Table 1. There was no difference in age as the mean age of the MH cohort was 76.4 ± 11.0 years compared to 81.2 ± 10.2 years in the Non-MH Group ($p = 0.069$). There was an approximately equal percentage of females in each group (75.0% vs 72.7%, $p = 0.821$). Finally, there was no significant difference in medical comorbidity burden as measured by the Charlson comorbidity index (mean 1.750 vs 1.399, $p = 0.350$).

Complete data with respect to imaging modalities used in the diagnosis of hip fractures is presented in Table 2. The category Initial Imaging Studies refers to imaging done during the encounter in which the MH cohort went undiagnosed with a hip fracture, whereas Final Diagnostic Imaging refers to the encounter in which the hip fracture was diagnosed based on imaging studies. On initial presentation, only 10 (50.0%) patients in the MH cohort had any imaging studies done of their hip (9 X-ray, 1 computed tomography (CT)), 4 (20.0%) received only knee x-rays, and 6 (30.0%) had no imaging studies done at all. Upon final diagnosis of hip fracture, Missed hip fractures were significantly less likely to be diagnosed with x-rays when compared to fractures that were not initially missed (75.0% vs 94.8%, $p = 0.004$) and significantly more likely to be diagnosed with magnetic resonance imaging (MRI) (20.0% vs 1.0%, $p<0.001$). There was no difference in likelihood of being diagnosed with CT (4.8% vs 4.1%, $p = 0.578$).

Comparison data with respect to specific clinical and injury pattern characteristics are shown in Table 3. Of 20 patients in the MH cohort, 4 (20%) were initially seen by their primary medical doctor (PMD), 11 (55%) were seen in the Emergency Department (ED), 2 (10%) were seen in an orthopedic office, and 3 (15%) were seen by a provider classified as other/unknown. Out of 7 (35%) patients from the MH cohort seen in some capacity at our facility, 5 (25%) were seen in the ED without an orthopedic consult and 2 (10%) were seen in an orthopedic office. The average time between presenting symptom onset/missed diagnosis and final diagnosis of hip fracture was 16.8 days ± 12.8 days (range 3-57). Patients in the MH cohort were significantly less likely to report an incident fall or trauma (75.0% vs 97.7%, $p<0.001$), to be able to ambulate after the onset of their symptoms of hip/knee pain (75.0% vs 7.0%, $p<0.001$), and to report knee pain (15.0% vs 3.6%, $p = 0.039$) when compared to hip fractures that were not missed. Patients in the Missed hip fracture cohort were significantly less likely to report hip pain (90.0% vs 98.6%, $p = 0.041$). With respect to baselines mental and physical deficits, patients in the MH cohort were significantly more likely to have an altered baseline mental status (40.0% vs 18.1%, $p = 0.003$), but there was no significant difference in baseline physical deficits (15.0% vs 5.1%, $p = 0.088$).

The MH cohort had a significantly higher proportion of femoral neck fractures compared to hip fractures that were not missed (75.0% vs 46.8%, $p = 0.013$). When classified by AO/OTA Fracture Dislocation Compendium classification, fractures in the MH group were more likely to be subcapital femoral neck fractures versus all other types of femoral neck and IT fractures (61.9% vs 28.2%, $p = 0.002$). No other fracture type (transcervical FN, basicervical FN, stable IT, unstable IT, or reverse obliquity IT) demonstrated a significant difference.

Table 1: Demographic information for the Missed (MH) and Non-Missed (Non-MH) Groups

	MH (n=20)	**Non-MH (n=700)**	**p value**
Age	76.4 ± 11.0	81.2 ± 10.2	0.069
Gender			0.821
Male	5 (25.0%)	191 (27.3%)	
Female	15 (75.0%)	509 (72.7%)	
CCI	1.75	1.40	0.350

Table 2: Diagnostic Imaging information for the Missed (MH) and Non-Missed (non-MH) Groups

	MH (n=20)	**Non-MH (n=700)**	**p value**
Initial Imaging Studies			
Imaging of the Hip	10 (50.0%)	-	
X-Ray	*9 (45.0%)*	-	
CT	*1 (5.0%)*	-	
MRI	*0 (0.0%)*	-	
Knee X-rays only	4 (20.0%)	-	
No imaging done	6 (30.0%)	-	
Final Diagnostic Imaging			
X-ray	15 (75.0%)	664 (94.8%)	0.004*

CT	1 (5.0%)	29 (4.2%)	0.578
MRI	4 (20.0%)	7 (1.0%)	<0.001*

Table 3: Clinical and Injury Information for the Missed (MH) and Non-Missed (Non-MH) Groups

	MH (n=20)	Non-MH (n=700)	p value
Initial Visit			
PMD	4 (20.0%)		
ED	11 (55.0%)		
Host institution	*5 (25.0%)*		
Ortho°	2 (10.0%)		
Other/Unknown	3 (15.0%)		
Time from Initial Miss to Dx	16.8 ± 12.8 days (range 3-57)		
Reported Fall/Incident Trauma			<0.001*
Yes	15 (75.0%)	684 (97.7%)	
No	5 (25.0%)	16 (2.3%)	
Ambulating After Symptom Onset			<0.001*
Yes	15 (75.0%)	49 (7.0%)	
No	5 (20.0%)	651 (93.0%)	
Reported Hip Pain			0.041*
Yes	18 (90.0%)	690 (98.6%)	
No	2 (10.0%)	10 (1.4%)	
Reported Knee Pain			0.039*
Yes	3 (15.0%)	25 (3.6%)	
No	17 (85.0%)	675 (96.4%)	
Altered Baseline Physical Status			0.088
Yes	3 (15.0%)	36 (5.1%)	
No	17 (85.0%)	664 (94.9%)	
Altered Baseline Mental Status			0.003*
Yes	8 (40.0%)	107 (15.3%)	
No	12 (60.0%)	593 (84.7%)	
Fracture Type			0.013*[a]
Femoral Neck	15 (76.2%)	328 (46.8%)	
Subcapital	*12 (60.0%)*	*198 (28.2%)*	0.002*[b]
Transcervical	*1 (5.0%)*	*95 (13.6%)*	0.500[b]
Basicervical	*2 (10.0%)*	*35 (5.0%)*	0.275[b]
Intertrochanteric	5 (25.0%)	372 (53.2%)	
Stable	*2 (10.0%)*	*189 (27.1%)*	0.122[b]
Unstable	*2 (10.0%)*	*154 (22.0%)*	0.275[b]
Reverse Obliquity	*1 (5.0%)*	*29 (4.1%)*	0.578[b]

°: both seen at host institution; a: any femoral neck vs any IT fracture; b: versus any other fracture pattern

Discussion

In this cohort of patients, we treated a small percentage of patients who initially were misdiagnosed as not having a hip fracture. These patients were less likely to have fallen, more likely to have complained of knee pain initially, be cognitively impaired and more likely to have an occult femoral neck than those whose hip fracture was readily diagnosed promptly. There are multiple factors what can contribute to the diagnosis of a hip fracture being missed upon a patient's initial presentation, from the type of provider that the patient sees to the quality of history and physical exam performed to the appearance on plain radiograph. Some of these factors, such as imaging issues have been studied extensively [9-13] while other areas, such as the quality of history and physical have not.

While the majority of the missed hip fractures studied here were not radiographically occult upon diagnosis at our facility, the literature on delay and misdiagnosis of radiographically occult hip fractures provides a good framework for concepts that we wished to explore. In a comparison between occult hip fractures that were initially misdiagnosed and fractures that were not, Hossain et al [9] found that misdiagnosed occult hip fractures were more likely in patients with poor mobility and cognitive impairment. Similarly, we found that patients with missed hip fractures were more likely to have baseline impaired mental status, although we found no difference between mobility in the two cohorts of our study.

Beloosesky et al [10] found no difference in the demographic or clinical characteristics of patients with occult hip fractures compared to radiographically occult hip fractures, although they also had a high proportion of subcapital femoral neck fractures in their occult fracture (75.9%), similar to the results of this study. Similarly, Ho et al [11] compared occult hip fractures with non-occult fractures and found no difference in clinical or demographic characteristics between the two groups. They did, however, have the unexpected finding of occult IT fractures being significantly more independent than their non-occult counterparts. Although it was not examined in this study, others [12,13] have found that delay or misdiagnosis of occult hip fractures leads to increased rates of surgery and fracture displacement. We cannot comment on

the presence of visibility on plain films as half missed hip fractures in the current study were not imaged appropriately (at all) at initial presentation.

The presence of an occult injury is only part of misdiagnosing hip fractures. Although the Missed hip fracture cohort was significantly less likely to be diagnosed definitively using x-rays, roughly 75% were eventually diagnosed with plain radiographs alone by the time they arrived at our institution. It is difficult to determine whether or not any of these fractures displaced or become more radiographically apparent because 50% of the MH cohort received no imaging of their hip on their initial visit and more than 50% were seen initially by a provider outside of our health system. In a series of 825 consecutive hospital admissions for hip fractures, Parker [14] found 16 cases in which the diagnosis was not made when the patient had initially visited the hospital. It was determined that failure to correctly interpret x-rays and failure to x-ray at all were the majority of cases, whereas only 3/16 were radiologically invisible. Although this percentage of misses is lower than ours, it should be noted that our study includes patients seen by any healthcare provider with the means to diagnose them or refer them for further workup, rather than only patients who were only seen twice at our hospital. It has been postulated by Parker that only examining visits to the hospital (versus including other outpatient providers) reduces the amount of missed fractures due to access to imaging and consulting providers.

Eastwood et al [15] reviewed femoral neck fractures in the elderly whose diagnosis was delayed by more than 24 hours, 20/33 patients were determined to be delayed by doctors failing to make the diagnosis. It could be argued that this is similar to the percentage of our missed fracture cohort who did not get imaging of the hip, indicating a lack of suspicion of injury on the part of their providers. This same study, similar to ours, found that errors leading to delay were more likely in patients who were confused or who had spontaneous fracture no associated with a reported fall. Another review of proximal femur fractures with diagnosis delayed by more than 24 hours done by Pathak et al [16] found that 60 of the 91 delayed patients who saw a medical provider did not get x-rays initially and only 9 fractures were radiographically occult. Delays were more likely to occur if the fracture was not associated with a fall and if the fracture was intracapsular, which were both findings associated with missed hip fracture cohort in our study cohort. A more recent study by Tour et al [17] looking at missed hip fractures in Sweden found that the vast majority of missed hip fractures found in their analysis (86%) were caused by lack of treatment, especially in primary care. Not administering x-rays and lack of follow-up for negative x-rays with clinical suspicion of hip fracture were the most common mistakes leading to missed hip fractures.

In our study, patients with missed hip fractures were more likely to have altered baseline mental status that affects their ability to give a history and more likely to be ambulatory following symptoms onset. They were more likely to have femoral neck fractures and to require advanced imaging in order to diagnose their fracture. They are also less likely to get any imaging of their hip done upon their initial visit. What does this tell us with respect to being able to diagnose more of these patients upon their initial presentation? As far as we know, we are the first study to report on ambulatory status after symptom onset as a factor associated with missed hip fractures.

This study has several limitations: it is retrospective and therefore depends on clinical background being documented in the medical record; we cannot say for certain that some "missed" fractures were not captured due to no clear documentation of a history that warranted inclusion; our relatively small sample size limits our ability to do statistical analysis of the missed fracture cohort.

Conclusions

The diagnosis of hip fracture in certain patient populations presenting with complaints of hip or knee pain, with or without a known fall regardless of ambulatory ability should always be considered, especially in the cognitively impaired so that delays in diagnosis and treatment can be avoided. All providers in the chain of care, including ED, primary care, orthopedic, and radiology, need to have a high index of suspicion in these patients in order to ensure that hip fractures are diagnosed in a timely manner.

Ethics Approval and Consent to Participate

This study was approved by the NYU School of Medicine Institutional Review Board and the Jamaica Hospital Medical Center Institutional Review Board. All participants were consented for participation in this study.

List of Abbreviations

CCI- Charlson Comorbidity Index
CT- computed tomography
ED- Emergency Department
FN- femoral neck
IT- intertrochanteric
MH- Missed Hip
MRI- magnetic resonance imaging
PMD- primary medical doctor

Data Availability

Data can be accessed by contacting the authors directly

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper

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Author Contributions

TW was involved in chart review, data compilation, reviewing x-rays for classification, analyzing data, writing/revising the manuscript. EK was involved in chart review, data compilation, and writing the manuscript. SK was involved in treating patients, and writing/revising the manuscript. KE was involved in treating patients, coming up with the concept for the study, and writing/revising the manuscript.

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