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Head Trauma From Falling Increases Subsequent Emergency Department Visits More Than Other Fall-Related Injuries in Older Adults

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Abstract

Objectives—Older adults with falls are at high risk for returning to the Emergency Department (ED) after their initial visit for a fall. We investigated whether fall-related injuries affected ED recidivism.

Design, Setting, Participants, Measurements—This was a retrospective chart review of patients 65 years old evaluated in an academic Level 1 trauma center ED for a fall from standing height or less and discharged. After Institutional Review Board approval, electronic medical record data was queried. Univariate and multivariable logistic regression models were used to determine factors associated with increased risk of returning to the ED over 90 days.

Results—Two hundred sixty three adults aged 65 and older were evaluated in the ED for a fall and discharged during the 18 month study period. Average age was 77 years and 70% were female. Injuries suffered include fractures (45%, n=117), head trauma (22%, n=58), abrasions, lacerations, or contusions (34%, n=88), or none (22%, n=57). Patients required emergency care frequently, with 5% (n=13)[95% CI, 2.3-7.6%] returning within 72 hours, 13% (n= 35)[95% CI, 9.2-17%] returning within 30 days and 22% (n=57)[95% CI, 17-27%] within 90 days.

Univariately, the odds of returning to the ED within 90 days was over two times higher for those with head trauma compared to those without (odds ratio (OR) 2.66). This remained significant in

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Author contributions: Lauren T. Southerland, Julie A. Stephens, Laura Phieffer, and Jeffrey M. Caterino designed the study. Lauren T. Southerland, JF, and Shari Robinson did the chart abstraction with the assistance of OSU research assistants Melanie Heinlein, Michael Hill, and Heidi Thompson. Lauren T. Southerland, Julie A. Stephens, and Jeffrey M. Caterino did the statistical analysis and data interpretation. Lauren T. Southerland, Julie A. Stephens, Joseph A. Rosenthal, and Jeffrey M. Caterino did the manuscript preparation. Joseph A. Rosenthal provided expert content on head trauma and Laura Phieffer provided expert advice on fractures.

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the multivariable model, which controlled for Charlson Comorbidity Index, fractures, soft tissue injuries, and ED observation unit use.

Conclusion—Over a third of older adults with minor head trauma from a fall will need to return to the ED in the following 90 days. These patients should receive close attention from primary care providers. The link between minor head trauma and ED recidivism is a new finding.

Keywords

Geriatric patients; falls; head trauma; Emergency Department

INTRODUCTION

Falls from standing height or less are a major health problem for older adults. Falls cause 61% of injuries in adults 65 years and older and are the most common cause of death in older adults in the National Trauma Data Bank.^{1,2} In 2010-2011, US Emergency Departments (EDs) cared for over 3 million older adults with falls.³ While many older adults require hospital admission for further medical care after an injurious fall, about half will be discharged back to home after their ED evaluation.^{4,5} The ED providers are often the only healthcare contact for these discharged patients, and these physicians may not have the time or training to ensure that the patient's home health care needs are met.⁶ For example, ED providers rarely provide the falls prevention counseling recommended by American Geriatrics Society guidelines.⁷ These discharged injured patients are at risk for functional decline and difficulty accessing resources at home. Indeed, half of older adults seen in the ED for injuries require increased home health services, and 15% will return to the ED in the month after their initial visit.⁸

Time constraints in the ED and a lack of training in fall prevention and home health needs assessments are large barriers to helping this population. Defining the group of older adult fallers who are the most at risk may allow health systems to focus limited ED resources. Prior studies have suggested that older adults with falls can be stratified by the injuries sustained during a fall and that these injuries are reflective of the patient's pre-fall health status. For example, those with fracture injuries tend to have fewer comorbidities and be community dwelling.^{9,10}

We wondered if grouping older adults by the injuries sustained from a fall would identify distinct populations, and if injury patterns predicted differing emergency healthcare needs after the fall. We performed a retrospective chart review to evaluate subsequent ED use for older adults who fell, were evaluated in the ED, and discharged to home. Patients were characterized based on their demographics, comorbidities, and injury patterns. Our main outcome was unscheduled health care use in the form of ED revisits within 90 days of their ED visit for a fall.

METHODS

Study Design

This study, approved by the local institutional review board, was a retrospective chart review designed to identify differences in ED usage among older adults with injuries from falls.

Study Setting and Population

Adults 65 years old diagnosed with a fall from standing height or less and discharged from the ED between August 2011 and February 2013 were included. The study setting was a tertiary care academic ED and a smaller affiliated community ED. Exclusion criteria included hospital admission, initial treatment at an outside facility, injuries from motor vehicle collision or other non-fall cause, or incomplete ED chart (defined as greater than 2 major data points missing, i.e. physical exam, physician chart note, diagnosis).

Study Protocol

The hospital's electronic medical record system (EPIC^R, Epic Systems Corporation, Verona, Wisconsin), a direct computer data entry system, was queried for ICD-9 falls codes (E880-E888) or ICD-9 fracture codes 807, 810-818, 820-826, plus discharged status in ED patients 65 years of age over 18 months. Patient demographics, primary care physician, injuries, comorbidities, treatment, prescriptions, observation status, and living situation were noted. Comorbidities not charted were presumed to be absent. Observation status involves an 8-48 hour stay in an ED based observation unit. The charts were reviewed by trained, semi-blinded chart abstractors and documented on a standardized abstraction form. Abstractors knew the primary outcome was ED revisits, but did not know that injury categories were the variable of interest. Abstractors were monitored and after training initial charts were re-reviewed for quality. Additionally, 10% of randomly selected charts were reviewed by a second abstractor to evaluate inter-rater reliability. As this was not a long term study with a prolonged collection phase, no abstractor monitoring over time was done.¹¹

Measurements

The primary outcome was ED revisits within 90 days of the incident visit. Two deaths within the time frame were excluded from the analyses. Injuries were classified as head trauma, fractures, or soft tissue/skin. Head trauma included any documentation of head injury (abrasion, facial or scalp laceration, or hematoma), concussion, or blunt force to the head. Patients were included in more than one group when they presented with more than one injury. The Ageless Charlson Comorbidity Index, a weighted numerical tally of comorbidities validated in ED patients, was calculated.^{12,13}

Data Analysis

Data was analyzed using SAS 9.3 (SAS Institute Inc., Cary, NC) and Stata v.13 (StataCorp, College Station, TX). Descriptive statistics included means and standard deviation, and proportions with 95% confidence intervals (CIs) as appropriate. Univariate logistic regression was performed on all variables of interest for the outcome of return to the ED within 90 days. The focus of the analyses became presence of any head trauma. As such a

multivariable logistic regression model was developed to assess the odds of return to the ED in 90 days for head injury while adjusting for those variables which univariately were significant (race, Charlson Comorbidity Index, fracture, skin/soft tissue injury, and ED observation status). The model was tested for linearity in the logit and fit.

RESULTS

Two hundred and ninety two patient charts were identified by computer query. Full chart review eliminated 5 charts as having no fall and another 24 for injuries caused by a mechanism other than a fall from standing height or less, leaving 263 included patients. Inter-rater reliability was good with kappa >0.85 for comorbidities, presence of a head injury, or presence of a fracture. Baseline demographics, comorbidities, and rates of injury are noted in Table 1. The majority (78%, n=206) suffered an injury from their fall and 31% (n=81) had injuries in multiple categories (Table 1). Five patients (3.5%) had multiple fractures.

Patients who sustained an injury were less likely to live in a skilled nursing facility and had fewer comorbidities as compared to those without injuries. Separating those with different injury types found a trend towards community dwelling in the patients with fractures (5% lived in skilled nursing facilities vs 13% for head trauma).

Overall, 22% (n=57) [95% CI, 17-27%] of older adults with a fall returned to the ED within 90 days (Table 1). Five percent (n=13)[95% CI, 2.3-7.6%] returned within 72 hours and 13% (n= 35)[95% CI, 9.2-17%] returned within 30 days. Within 90 days, fourteen patients (5.3%) [95% CI 2.9-8.8%] presented with repeat falls (17 revisits for falls in total) and two of the patients who initially presented with a fracture injury had subsequent fractures. Both of those patients with repeat fractures were again discharged home. Two patients died within 90 days, both had no recorded injuries from their initial falls. Causes of revisits were attributed to the initial fall-related injuries in 8 out of 26 revisits for patients with head trauma (30%), and 15 of 85 revisits for those without head trauma (17%), with a chi squared of 0.038.

Univariate logistic regression analyses demonstrated multiple variables associated with return within 90 days (Table 2). The presence of any head trauma was the only injury (or lack of injury) significantly associated with ED recidivism with the odds of returning to the ED within 90 days over two times higher compared to those without head trauma (OR 2.66, [95% CI, 1.4-5.1%], p=0.003). This remained significant in the multivariable regression model after adjusting for observation status, skin/soft tissue injury, fracture, Charlson Comorbidity Index and race (Table 3). The Hosmer-Lemeshow goodness-of-fit test for this model was adequate (p=0.293). The likelihood ratio (LR) for return in those with head trauma was 2.1. Analysis of fractures by anatomical groups again suggested that head trauma was associated with increased risk of return, as the small number of patients with facial or skull fractures (n=8) had a high rate of return (63%)[95% CI, 24-91%]. Patients with upper extremity fractures (n=72), lower extremity fractures (n=32), and ribs or spinal fractures (n=5) had lower rates of 90 day return (19/109, 17%)[95% CI 10-26%].

Although only 13 patients were kept in an ED observation unit, the adjusted odds of returning to the ED within 90 days was almost three times higher than those not kept in the observation unit (adjusted odds ratio 2.98, [95% CI 0.88-10%]).

DISCUSSION

Older adults evaluated in the ED for a fall have a high rate of ED recidivism over the subsequent 3 months. In our study 13% revisited within 30 days of their fall, which is similar to prior rates for injured elders at other institutions.⁸ For perspective, this is also similar to the 30 day revisit rate for patients with chronic obstructive pulmonary disease exacerbations (12%), or the 30 day revisit rate after admission for congestive heart failure exacerbation (15%).^{14,15} Rates of injuries in our population were also similar to other institutions, as 22% of our population had minor head trauma, as compared to 24% in the literature.¹⁶ Therefore, our population of older adults with falls in the ED is likely similar to other institutions.

By 90 days, 22% of older adults with a fall had returned to the ED. This is higher than the 15% rate for all discharged older adults.¹⁷ This suggests that an ED visit for a fall should be seen as an opportunity to address unmet patient care needs. Older adults with falls are a higher risk population that could benefit from early interventions to reduce their need for recurrent emergency care. Whether one considers falling itself as a chronic condition or as the outcome of other chronic conditions and underlying factors, older adults with falls frequently have unmet healthcare needs after their ED visit and require frequent emergency care.

We found that older adults with head trauma had over twice the risk of returning to the ED as those with no injuries or other injuries (OR 2.66). This association remained durable despite controlling for other influencing factors, including other injuries and race. Caucasian race did decrease the rate of ED recidivism, however our population for this study is derived from both a suburban academic ED and a more diverse and socioeconomically disadvantaged urban community ED. Therefore non-Caucasian race may be a surrogate marker for less access to care and socioeconomic disadvantages. Another possible confounder in this study was that we included patients who were kept in an ED observation unit (a 24 hour stay unit for further care needs). This was also associated with an increased return rate. As these patients already required further care than a short ED visit could provide, this is not surprising. However, observation unit use was controlled for in the multivariable model and the head trauma association remained robust.

This association between head trauma and ED recidivism is a surprising finding. Prior studies evaluating frailty scoring systems or comorbidity indexes to determine the risk of 90 day ED returns in older adults were unable to find likelihood ratios for return greater than 1.5.¹⁸ Our data, with a LR of 2.1 for those with head trauma after a fall, suggests that head trauma should be included in clinical prediction tools for older adults with falls. As a retrospective study, we cannot speculate whether this is an effect of the head trauma itself or if head trauma is a marker for other underlying factors. As these patients were discharged to home from the ED, they were functional and did not require inpatient monitoring for severe

concussion or other severe head trauma. As this was a retrospective review study, we were not able to assess baseline mental status, Glasgow Coma Scores, or evaluate for signs of concussion. There could be subtle injuries or cognitive deficits that are missed in the ED setting that might contribute to increased subsequent healthcare needs. Indeed, the rate of concussions in older adults after minor head trauma is not known.

This study also suggests that primary care physicians should monitor their older adult patients with mild head trauma closely. Many of the ED revisits were due to problems from the injuries sustained, including some with headache in the head trauma group. This suggests that these patients may be struggling with their symptoms after an injury. Mild head trauma has been found to be an independent predictor of increased mortality in older adults,¹⁹ and is associated with increased symptoms of major depressive disorder and decreased cognition and functional status.²⁰ Older adults also may have slower recovery from a mild traumatic brain injury than their younger peers.²¹ Traumatic brain injury can be associated with gait imbalances²² and mental status changes, which could predispose to further falls. Our study found that 5% of the patients had a subsequent fall within 90 days requiring another ED visit. This is lower than the estimate of 31% at 6 months, but our data includes only the falls requiring an ED visit, not all falls.²³ Other research into the cognitive effects of trauma in older adults found that 45% of trauma patients had significant cognitive deficits 3 months after their injuries, and that the presence of new or worsening cognitive deficits was not related to head injury.²⁴ This suggests that trauma itself may cause an inflammatory or other systemic condition that can worsen cognitive decline. In our study, the patients with fractures or other non-head trauma did not have an increased ED use over those without injuries, so general trauma alone was not a factor. Prospective studies of older adults in the ED discharged with minor head trauma are needed to evaluate for signs of cognitive decline and further determine the consequences of traumatic falls.

This study is confined by the limitations of a single institution chart review. Other institutions may have different criteria for admission or discharge of patients with falls. Our rates of ED visits are similar to prior noted rates for injured other adults, which suggests that our institution's practices are not atypical. Additionally, comorbidities or injuries may have gone uncharted. Comorbidities not charted were presumed to be absent, but handling missing data or uncharted negatives in this manner may introduce bias. It is possible that comorbidities do play a larger role, and this should be addressed in further prospective studies. Finally, patients could also present to multiple other EDs in the area, which would result in increased ED recidivism undetected by our study.

Overall, these data confirm prior studies that older adults seen in the ED for falls are a high risk population for further falls, death, and ED recidivism. Older adults are a heterogeneous population, and grouping by injuries sustained from the fall may allow future studies to tailor interventions to prevent functional decline and unscheduled healthcare needs after a fall. Additionally, future studies of clinical risk prediction tools should consider the addition of head trauma as a risk factor. Finally, older adults with minor head trauma are a particularly at-risk population that deserves close attention in the outpatient setting.

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Demographics, comorbidities, and rates of injury in an emergency department cohort of patients 65 years and older presenting to the ED with a fall.*

Table 1

	All Patients		No Injuries		Any Injury		Fractures		Injury Type:			
	n=263		n=57		n=206		n=117		Head Trauma	Skin/Soft Tissue		
Age	77	[8.63]	78	[8.43]	76	[8.65]	75	[8.0]	76	[8.6]	78	[8.84]
Female Gender	70%	[64-75]	67%	[53-79]	71%	[64-77]	70%	[61-78]	74%	[61-85]	72%	[62-80]
Race (percent white)	62%	[56-68]	60%	[46-72]	62%	[55-69]	67%	[57-75]	72%	[60-83]	58%	[48-67]
Skilled Nursing Facility	12%	[8.5-17]	26%	[16-40]	11%	[7.2-16]	5%	[2-11]	14%	[6-25]	13%	[8-21]
Charlson Comorbidity Index	1.9	[1.7]	2.4	[1.7]	1.7	[1.7]	1.6	[1.6]	1.9	[1.7]	1.8	[1.8]
Dementia	19%	[14-24]	30%	[18-43]	16%	[11-22]	12%	[7-19]	21%	[11-33]	18%	[11-25]
90 day ED Recidivism	22%	[17-27]	23%	[13-36]	17%	[12-23]	20%	[13-28]	36%	[24-50]	25%	[17-34]

* Numbers do not add to total of 263 as some patients fit in multiple categories due to multiple injuries. Percentages are reported with 95% Confidence Intervals and integers as means with standard deviation.

Table 2

Odds ratio of ED recidivism at 90 days based on univariate analysis of demographic variables, types of injury, and place of residence for ED patients with falls.

	odds ratio	95% CI	P
Age	1.01	[0.98-1.04]	0.507
Gender	1.12	[0.60-2.11]	0.720
Caucasian race	0.75	[0.41-1.35]	0.339
Charlson Comorbidity Index	1.25	[1.01-1.54]	0.037
Head trauma	2.66	[1.39-5.07]	<0.010
Fracture	0.81	[0.44-1.46]	0.478
Skin/Soft Tissue Injury	1.77	[0.97-3.24]	0.062
Observation status	3.34	[1.08-10.38]	0.037
Discharge (reference=community)			
Assisted Living	1.71	[0.50-5.80]	0.393
Skilled Nursing Facility	1.50	[0.65-3.48]	0.343

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Table 3

Multivariable logistic regression analysis of factors predicting subsequent ED use.

	Odds Ratio	95% CI	p
Observation status	2.98	[0.88-10.06]	0.079
Head trauma	2.35	[1.06-5.20]	0.036
Skin/Soft Tissue Injury	1.39	[0.68-2.85]	0.372
Fracture	1.24	[0.64-2.40]	0.518
Charlson Comorbidity Index	1.20	[1.01-1.43]	0.036
Caucasian race	0.56	[0.29-1.06]	0.076

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