

Geriatric Falls: Injury Severity Is High and Disproportionate to Mechanism

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Objective: Falls are a well-known source of morbidity and mortality in the elderly. Fall-related injury severity in this group, however, is less clear, particularly as it relates to type of fall. Our purpose is to explore the relationship between mechanism of fall and both pattern and severity of injury in geriatric patients as compared with a younger cohort.

Methods: Our trauma registry was queried for all patients evaluated by the trauma service over a 412-year period (1994–1998). Two cohorts were formed on the basis of age greater than 65 or less than or equal to 65 years and compared as to mechanism, Injury Severity Score (ISS), Abbreviated Injury Scale score, and mortality.

Results: Over the study period, 1,512 patients were evaluated, 333 greater than 65 years and 1,179 less than or equal to 65 years of age. Falls were the injury mech-

anism in 48% of the older group and 7% of the younger group ($p < 0.05$). Falls in the older group constituted 65% of patients with ISS >15, with 32% of all falls resulting in serious injury (ISS >15). In contrast, falls in the younger group constituted only 11% of ISS >15 patients, with falls causing serious injury only 15% of the time (both $p < 0.05$). Notably, same-level falls resulted in serious injury 30% of the time in the older group versus 4% in the younger group ($p < 0.05$), and were responsible for an ISS >15 30-fold more in the older group (31% vs. <1%; $p < 0.05$). Abbreviated Injury Scale evaluation revealed more frequent head/neck (47% vs. 22%), chest (23% vs. 9%), and pelvic/extremity (27% vs. 15%) injuries in the older group for all falls (all $p < 0.05$). The mean ISS for same-level falls in the older group was twice that for the younger

group (9.28 vs. 4.64, $p < 0.05$), whereas there was no difference in mean ISS between multilevel and same-level falls within the older group itself (10.12 vs. 9.28, $p > 0.05$). The fall-related death rate was higher in the older group (7% vs. 4%), with falls seven times more likely to be the cause of death compared with the younger group (55% vs. 7.5%) (both $p < 0.05$). Same-level falls as a cause of death was 10 times more common in the elderly (25% vs. 2.5%, $p < 0.05$).

Conclusion: Falls among the elderly, including same-level falls, are a common source of both high injury severity and mortality, much more so than in younger patients. A different pattern of injury between older and younger fall patients also exists.

Key Words: Falls, Geriatric trauma, Injury Severity Score.

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As the population of the United States ages, the ramifications of providing health care for this sector become increasingly important. It is expected that by the year 2030 the U.S. population over the age of 65 will represent 25% of the total population, roughly double the current proportion.^{1,2} Trauma affecting this age group thus takes on similar importance. Trauma remains the seventh leading cause of death in patients over 65 years of age. Moreover, it is well established that the elderly, although injured less often, are more likely to die from their injuries than are their younger counterparts. With geriatric trauma accounting for a disproportionate one third of all trauma-related expenses currently, it can be expected that the cost of caring for the injured elderly will rise dramatically.³

Falls constitute the most common mechanism of injury in the geriatric population, with an annual incidence of 30% in those over 65 rising to 50% in those over 80 years of age.⁴ In our own state, recent data from the State of Connecticut Committee on Trauma regarding geriatric injury corroborate this finding, with 64% of injuries to patients 70 years old or older occurring as the result of falls.⁵ Although multilevel falls do occur, same-level falls predominate. The morbidity of these falls is significant; nearly 40% of all nursing home admissions are in some way related to falls.⁶

Outcome after trauma in this age group has been studied extensively, both short and long term. The majority of the literature supports aggressive care of the injured elderly, including those over age 75 and with multiple injuries.^{7–16} Overall mortality from falls has declined over the last 30 years, primarily as a result of improved trauma management.¹⁷

Much has been reported regarding geriatric falls including patient profile, environmental factors, frequency rates, and preventive measures.^{17–23} Risk factors predisposing this sector of the population have been well described previously in both the community and nursing home settings.⁵ No published study, however, addresses the association between falls of all types, injury severity, and pattern of injury, specifically

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Table 1 Mechanism of Injury

| E-Code | Description |
|--------|---|
| 880.1 | Fall from escalator |
| 880.2 | Fall from sidewalk/curb ^a |
| 880.9 | Fall on or from stairs/steps |
| 884.2 | Multilevel fall—chair ^a |
| 884.3 | Multilevel fall—wheelchair ^a |
| 884.4 | Multilevel fall—bed ^a |
| 884.5 | Multilevel fall—other furniture ^a |
| 884.6 | Multilevel fall—commode ^a |
| 884.9 | Multilevel fall—unspecified |
| 885.0 | Same-level fall—slipping/tripping ^a |
| 886.0 | Same-level fall—sports |
| 886.9 | Same-level fall—shoving (not sports-related) ^a |
| 887.0 | Other and unspecified fall |

^a Same-level falls.

the morbidity associated with the common same-level fall. This retrospective analysis was undertaken to explore the relationship between the mechanism of fall and both severity and pattern of injury in geriatric patients as compared with a younger cohort.

MATERIALS AND METHODS

The trauma registry at a Level II trauma center was queried for all patients evaluated by the trauma service over the 412-period from 1994 to 1998. Two cohorts were formed on the basis of age greater than 65 years or less than or equal to 65 years and compared as to mechanism of injury, Abbreviated Injury Scale (AIS) score,²⁴ Injury Severity Score (ISS),²⁵ and mortality. Falls were stratified as either same level or multilevel. Same-level falls were defined by the following E-codes: 880.1, 884.2, 884.3, 884.5, 884.6, 885.0, and 886.9 (Table 1), and included those from a chair, wheelchair, commode, sidewalk/curb, slipping/tripping, and shoving (not related to sports). Multilevel falls included those from an escalator, stairs/steps, bed, unspecified, and sports-related. Excluded were falls from great heights in either cohort.

Statistical analysis was performed using the χ^2 method, Fisher's exact test, two-sample *t* test, and confidence interval. Survival was defined as discharge from the hospital, and deaths were defined as those occurring during the same admission for trauma. ISS was generated from Tricode software (Trianalytics, Bel Air, MD) according to the medical record. An ISS >15 was chosen as the accepted standard of severe injury. Patients over the age of 65 are referred to as the older group; those 65 years of age or under constitute the younger group. Preexisting comorbid disease and length of stay were not evaluated, nor was long-term follow-up conducted.

RESULTS

Over the 412-year period, a total of 1,512 patients were evaluated by the trauma service, 333 older than 65 and 1,179 65 years of age or younger. Falls were the mechanism of injury in 48% (*n* = 159) of the older group compared with 7% (*n* = 83) in the younger group (*p* < 0.05), comparable to previously reported national statistics (Table 2). The balance of mechanisms consisted of motor vehicle crashes, penetrating trauma, pedestrians struck, and other assault/injury.

Of the patients with an ISS >15, 65% were a result of falls in the group older than 65, whereas only 11% in the group younger than 65 occurred secondary to this mechanism (*p* < 0.05). Falls resulted in serious injury (ISS >15) 32% of the time in the older group and resulted in serious injury only 15% of the time in the younger group (*p* < 0.05). When stratified as same-level and multilevel falls, serious injury was further skewed toward the older group. Same-level falls resulted in serious injury (ISS >15) 30% of the time in the older group versus 4% in the younger group, and were responsible for an ISS >15 30-fold more in the older group (31% vs. <1%, both *p* < 0.05). The mean ISS for same-level falls in the older group was 9.28 (SD, 7.22) compared with 4.64 (SD, 4.96) in the younger group (*p* < 0.05). In the older group, the mean ISS for multilevel falls was 10.12, similar to that for same-level falls (9.28, *p* > 0.05).

Regarding the pattern of injury for all falls, older patients sustained more frequent injuries compared with younger pa-

Table 2 Fall Severity and Mortality

| | Older | Younger | <i>p</i> Value |
|---|---------------|---------------|----------------|
| Fall as mechanism | 159/333 (48%) | 83/1,179 (7%) | <0.05 |
| Fall-related ISS >15 | 50/159 (31%) | 12/83 (15%) | <0.05 |
| Fall as % of all ISS >15 | 50/77 (65%) | 12/107 (11%) | <0.05 |
| Same-level fall-related ISS >15 | 24/81 (30%) | 1/28 (4%) | <0.05 |
| Same-level fall as % of all ISS >15 | 24/77 (31%) | 1/107 (<1%) | <0.05 |
| Mean ISS same-level falls | 9.28 | 4.64 | <0.05 |
| Fall-related deaths/all deaths | 11/20 (55%) | 3/40 (7.5%) | <0.05 |
| Same-level fall deaths/all deaths | 5/20 (25%) | 1/40 (2.5%) | <0.05 |
| Fall-related death rate ^a | 11/159 (7%) | 3/83 (4%) | <0.05 |
| Same-level fall-related death rate ^b | 5/81 (6.2%) | 1/28 (3.6%) | NS |

^a Fall-related deaths/all falls.

^b Same-level fall-related deaths/all same-level falls.

Table 3 AIS Pattern for All Falls

| AIS Region | Older (n = 159) | Younger (n = 83) | p Value |
|------------------|--------------------|---------------------|---------|
| Head/neck | 75 (47%) | 18 (22%) | 0.00 |
| Face | 14 (9%) | 10 (12%) | 0.264 |
| Chest | 37 (23%) | 7 (8%) | 0.003 |
| Abdomen | 3 (2%) | 10 (12%) | 0.001 |
| Pelvis/extremity | 43 (27%) | 12 (14%) | 0.021 |
| Skin/soft tissue | 75 (47%) | 50 (60%) | 0.025 |

tients in the head/neck region (47% vs. 22%), chest region (23% vs. 9%), and pelvic/extremity region (27% vs. 15%) (all $p < 0.05$). Younger patients, on the other hand, sustained abdominal and skin/soft tissue injuries more frequently than their older counterparts (12% vs. 2%, and 62% vs. 47%, respectively, all $p < 0.05$) (Table 3). Moreover, for same-level falls determined on the basis of AIS score, head and neck injuries were more severe on average in the older group (AIS score of 3.5 vs. 2.86, $p < 0.05$) as were pelvic/extremity injuries (2.48 vs. 2, $p < 0.05$). No regional severity differences between the two groups were identified for all falls.

Regarding fall-related deaths, there was a significant difference between the older and younger cohorts; 11 of 159 (7%) and 3 of 83 (4%), respectively, died from injuries related to a fall ($p < 0.05$). Furthermore, 11 of the 20 deaths that occurred in the older group were the result of a fall (55%), whereas only 3 of 40 deaths in the younger group were fall related (7.5%) ($p < 0.05$). Deaths from same-level falls, as a proportion of all deaths, were significantly higher in the older group as well (5 of 20 [25%] vs. 1 of 40 [2.5%], $p < 0.05$). The mean ISS for fall-related deaths in the older group was 16; 7 had an ISS > 15 . The cause in 7 of these 11 deaths was the result of closed head injury (CHI); two patients died from pulmonary complications (Table 4). Of the 11 deaths from falls in the older group, 5 resulted from same-level falls. One of the three deaths from falls in the younger group also was a result of a same-level fall, rendering same-level fall death rates not statistically significant between older and younger cohorts. This single same-level fall death in the younger group occurred in a patient with a congenital defect (osteogenesis imperfecta) resulting in recurrent long-bone fractures. His death followed operative fixation of a pathologic acetabular fracture as a result of coagulopathy and hemorrhage. The balance of deaths in the younger group resulted from CHI.

DISCUSSION

Falls represent a significant source of morbidity and mortality among the elderly, accounting for nearly half of all geriatric trauma. Indeed, in our study not only were falls the principal mechanism of injury among the elderly but the more severely injured elderly patients were predominantly those involved in falls. The ISS was worse in the older group for all falls and same-level falls as compared with the younger

Table 4 Fall Related Deaths

| Patient No. | Cause of Death | ISS | Body Region ^{AIS} |
|---------------------|--|-------------|---|
| >65 Years | | | |
| 1 | SDH/IVH/SAH/ICH | 25 | 1 ⁵ |
| 2 | Pneumonia/C-spine fracture | 5 | 1 ² 3 ¹ |
| 3 | SDH | 16 | 1 ⁴ |
| 4 | SDH/SAH/arrhythmia | 16 | 1 ⁴ |
| 5 | SDH | 16 | 1 ⁴ |
| 6 | SDH/cerebral contusion/MI | 25 | 1 ⁴ 5 ³ |
| 7 | Respiratory failure/pneumonia | 9 | 3 ³ |
| 8 | C-spine fracture/ischemic stroke | 9 | 1 ³ |
| 9 | SDH | 24 | 1 ⁴ 3 ² 5 ² 6 ¹ |
| 10 | Cerebral contusions/SAH | 9 | 1 ³ |
| 11 | Thoracic spinal cord injury | 20 | 1 ⁴ 3 ² |
| Mean ISS | | 15.8 | |
| ≤65 Years | | | |
| 1 | Pelvic fracture/postoperative hemorrhage | 4 | 5 ² |
| 2 | SDH | 25 | 1 ⁵ |
| 3 | SDH | 17 | 1 ⁴ 6 ¹ |
| Mean ISS | | 15.3 | |

MI, myocardial infarction; ICH, intracerebral hemorrhage; IVH, intraventricular hemorrhage; SDH, subdural hematoma; SAH, subarachnoid hemorrhage; ISS, injury severity scale; AIS, Abbreviated Injury Scale.

Body Region: 1, Head/Neck; 2, Face; 3, Chest; 4, Abdomen/pelvic contents; 5, Extremity or pelvic girdle; 6, Skin/subcutaneous tissue.

AIS: 1, Minor; 2, Moderate; 3, Serious; 4, Severe; 5, Critical; 6, Maximum.

group. Interestingly, for the older group the ISS in the same-level and multilevel fall groups was similar. In fact, nearly one third of the older group sustained severe injuries regardless of whether the fall was from a commode, for example, or down a flight of stairs.

In this retrospective study, falls were also found to account for a significantly different injury profile and severity between the older and younger cohorts. The analysis of AIS data pointed out that patients in the older group sustained more frequent head/neck injuries, more frequent chest injuries, and more frequent pelvis/extremity injuries when compared with younger fall patients. Both abdominal and skin/soft tissue injuries, conversely, were more common in the younger cohort. Geriatric same-level fall patients, moreover, sustained more severe head/neck and pelvic/extremity injuries than their younger counterparts.

When analyzing fall-related deaths, proportionately more occurred in the older group. Similarly, a disproportionately high number of deaths from same-level falls occurred in the older group. This further supports the premise that these simple falls, despite their seemingly innocuous mechanism, can result in disproportionately severe injury and even death. The most common cause of death was CHI. The single same-level fall-related death in the younger group probably prevented statistically significant conclusions regarding the

same-level fall death rate. Interestingly, the condition that rendered him susceptible to severe injury equated his physiologic status to that of an elderly person.

Clearly, the “graying of America” has huge implications on U.S. health care in general and for those institutions caring for injured patients in particular. This article highlights how simple and commonplace mechanisms often result in devastating injury and death in the geriatric patient. A high index of suspicion for potential serious injury even after simple same-level falls is necessary to diagnose and treat geriatric patients in a timely fashion. Efforts at preventing falls clearly need to include strategies to decrease both same-level and multilevel falls.

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