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Do characteristics of seriously injured older adults differ from those of their younger counterparts in the emergency department?

Ayhan AKÖZ[1]*, Memet IŞIK[2], Hüseyin ŞAHİN[1], Mücahit EMET[1]

[1]Department of Emergency Medicine, Faculty of Medicine, Atatürk University, Erzurum, Turkey
[2]Department of Family Medicine, Faculty of Medicine, Atatürk University, Erzurum, Turkey

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Aim: To analyze the injury characteristics of younger and older adult trauma victims.

Materials and methods: This was a prospective, cross-sectional, observational, and single-center study including both younger adult and geriatric trauma patients. The relationships between the age groups and the number of consultations in the emergency department (ED) were compared with analysis of covariance after adjusting for Injury Severity Score (ISS).

Results: The data consisted of 779 patients, 131 (16.8%) of whom were elderly. The intensive care unit admission rate was 7.2%. Our results showed a significantly higher incidence of intracranial hemorrhage, fracture and/or dislocation of the femur, and fracture of the thoracic vertebra in the elderly patients, and acute abdomen, bowel injury, and pelvic fracture in younger adults. After adjusting for ISS and total consultations, the length of stay in the ED was significantly shorter in the elderly compared to the younger adults (115 min vs. 132 min; $F = 24.2$; $P < 0.0001$). After controlling for ISS, the total number of consultations among the elderly was significantly lower than that of the younger adults (2.07 ± 1.42 vs. 2.53 ± 1.44; $P < 0.0001$).

Conclusion: The findings of this study suggest that the characteristics of seriously injured older adults admitted to our ED differ from those of their younger counterparts.

Key words: Elderly, geriatric, trauma, injury, health care quality, length of stay, consultation, outcome, emergency department

1. Introduction

There is a global fact faced by emergency departments (EDs) all over the world: the elderly admittance to emergency services grows larger day by day. Worldwide, about 946,000 trauma victims aged 65 years and older are estimated to die from injuries each year (1). Thus, it is inevitable to make adjustments in patient care to deal with patient problems in EDs in the future (2).

In 2007, age-related demographics in Turkey revealed that the age group of 15–64 years contained 66.5% of the population, and the age group of 65 and older consisted of 7.1% (3). The percentages of the elderly are estimated to increase to 9.1% and 18.2% by the years 2025 and 2050, respectively (4). In our country, the elderly population has not received significant policy attention, due to their smaller percentage of the population as compared to the younger groups (3). In Turkey, the admission rate of elderly trauma victims to EDs was about 5% (5), and trauma was not included in the first 5 leading causes of death for geriatric patients (6).

Elderly patients present to the ED with more emergencies, more comorbidities, and more atypical presentations than younger people (7). It is said that the elderly are not cared for enough in EDs, even though they need special attention (8). Despite the fact that the elderly require a longer hospital stay, suffer different mechanisms of injury, experience more complications than younger patients, and account for more total hospital charges than younger trauma victims, relatively little research has been done on trauma in the elderly (9). Additionally, the finding that the elderly do not receive enough trauma center care brings forth additional questions (10). Do we give enough care to older trauma patients in the ED, or does suboptimal care exist for this age group? Do poor outcomes after injury in the geriatric patient population (11) lead to the premature withdrawal of care?

The purpose of this study was to first analyze the injury characteristics of older and younger trauma victims. After adjusting for consultation numbers and Injury Severity Score (ISS), we checked whether older severe trauma patients spent more time and utilized more consultations in the ED. We hypothesized that older trauma patients spend more time and need more trauma-related consultations in the ED as compared to younger adults.

* Correspondence: akozayhan@gmail.com

2. Materials and methods

2.1. Study design and protocol

The Aziziye Medical Faculty Hospital is a 600-bed tertiary care teaching hospital with full specialty services, and it is a regional trauma center. All trauma patients admitted to our ED are seen by emergency residents or doctors in rotation from different departments.

This study was a prospective, cross-sectional, observational, and single-center study including both younger adults and geriatric trauma patients who were admitted to our ED and hospitalized. The dataset included patient demographics; mechanism of injury (MOI); diagnoses; patient management data (surgical and nonsurgical procedures, intensive care admittance); length of time in the ED, intensive care unit (ICU), and hospital stay; use of consultation services in the ED; Abbreviated Injury Scale (AIS); and Injury Severity Score (ISS). The data were recorded within 24 h using a standardized form developed for this study, which was filled in by emergency doctors in the ED and cross-checked using hospital medical records. All patients were followed for the length of their hospital stay.

2.2. Definitions

The patients were divided into 2 cohorts based on age: "elderly patients" were defined as those aged 65 and above, while patients between 18 and 64 were referred to as "adults."

"High-impact traumas" were accepted as motor vehicle accidents (MVA), falls from heights, and gunshot injuries. "Low-impact injuries" were accepted as ground-level falls, stabbings, and assault injuries.

Length of stay (LOS) in the ED was a continuous variable measured in minutes from the time the patient registered in the ED to the time the patient was admitted to a definitive location (operating room or inpatient bed).

Injury type was classified according to the updated AIS (12). Injury severity was calculated by the ISS.

2.3. Inclusion and exclusion criteria

Although many trauma registries have chosen not to include isolated hip fractures and falls, recent data suggest that they should be included in the trauma registry if the registry is to document the full outcome and resource use of the trauma population (13). Thus, we have included falls in our study.

We excluded patients who died in the ED, because these patients' diagnostic procedures were incomplete and the autopsy findings were unavailable. Other excluded cases were those with burn or electrical injuries solely, those with no acute injury (late effects of previous injury), poisoning cases, and patients under 18 years old. Patients with minor injuries who were discharged directly from the ED, interhospital transfers, and patients not meeting trauma registry criteria were excluded, as well.

2.4. Data analysis

The means and standard deviations were computed for the continuous variables, and percentages were computed for the categorical variables. Differences in the continuous variables were tested using Student's t-test. Differences in the categorical variables were calculated by means of the chi-square statistic. A covariance analysis was used to compare ED LOS between younger adults and the elderly after adjusting for consultation numbers and ISS. The relationships between the age groups and the number of consultations in the ED were also compared with an analysis of covariance (ANCOVA) after adjusting for ISS. Spearman's rank correlation coefficient was calculated to compare the relationship between ED LOS and total consultations. The statistical evaluation was performed using SPSS 11.0. We considered $P < 0.05$ to be statistically significant.

3. Results

The study sample consisted of 779 patients, 131 (16.8%) of whom were elderly. The mean age was 43.9 ± 19.6 years (range: 18–96; adults: 37.6 ± 13.2; elderly: 74.9 ± 7.1). Of the patients, 21.1% (n = 164) were female, and the mean ISS was 12.6 ± 8.7 (range: 1–61). The admission rate to the ICU was 7.2% (n = 56). For adults and the elderly, 25.6% (n = 166) and 28.2% (n = 37) of the patients' ISS were >15, respectively (P = 0.52). For adults and the elderly, 6% (n = 39) and 3.1% (n = 4) of the patients had ISS scores of >30, respectively (P = 0.18). A comparison of the demographic characteristics among the age groups demonstrated no meaningful differences between the 2 groups, except for mechanism of injury, which was "blunt" for both groups predominantly (see Table 1). Adults faced significantly more high impact traumas than the elderly (75.4% vs. 57.3%; P < 0.0001). The comparison of specific diagnoses showed that the age groups differed significantly in 6 injury types (Table 2).

3.1. ED LOS

Although statistically nonsignificant, in the younger adult group women tended to stay longer in the ED compared to men (137 ± 92 min vs. 128 ± 81 min; P = 0.7). It was the opposite for the elderly (98 ± 68 min vs. 116 ± 74 min; P = 0.4). Injuries that had the longest stays in the ED were as follows: MVA (142 ± 73 min); falls from heights (142 ± 77 min), and assault (117 ± 87 min) for adults; and MVA (138 ± 66 min), assault (130 ± 15 min), and falls from heights (118 ± 88 min) for the elderly. Adults with high-impact injuries stayed significantly longer in the ED compared to low-impact injuries (144 ± 84 min vs. 97 ± 70 min, P = 0.037), but this did not differ significantly for the elderly (128 ± 75 min vs. 87 ± 63 min, P = 0.2). After adjusting for ISS, ED LOS differed significantly between trauma patients that were admitted to the ICU and patients transferred to

Table 1. Descriptors and differences between the age groups.

Characteristics	Age groups						
	Adult			Elderly			P-value
	Mean or n	SD or %	95% CI	Mean or n	SD or %	95% CI	
Demographics							
Female	129	19.9	16.8–23.0	35	26.7	19.1–34.3	NS
Injury severity							
GCS	13.9	2.9	13.7–14.1	14.3	2.2	13.9–14.7	NS
ISS	12.6	9.0	11.9–13.3	12.6	7.1	11.4–13.8	NS
AIS (head and neck)	0.8	1.5	0.68–0.92	1.1	1.8	0.79–1.41	0.038
AIS (face)	0.2	0.6	0.15–0.25	0.1	0.5	0.01–0.19	NS
AIS (chest)	0.9	1.4	0.78–1.02	0.8	1.3	0.58–1.02	NS
AIS (abdomen)	0.8	1.4	0.69–0.91	0.6	1.1	0.41–0.79	0.053
AIS (extremity)	1.2	1.3	1.1–1.3	1.3	1.4	1.06–1.54	NS
AIS (external)	0.9	0.5	0.86–0.94	0.7	0.5	0.61–0.79	<0.0001
Injury type							
Falls from heights	85	13.1	10.5–15.7	26	19.8	13.0–26.7	0.044
Ground-level falls	45	6.9	5.0–8.9	45	34.4	26.2–42.5	<0.0001
Stabbings	64	9.9	7.6–12.2	2	1.5	0–3.0	0.002
Gunshot injuries	72	11.1	8.7–13.5	4	3.1	0.1–6.0	0.005
Assaults (blunt)	34	5.2	3.5–7.0	3	2.3	0–4.9	NS
MVA	281	43.4	39.5–47.2	37	28.2	20.5–36.0	0.001
Other injury types	67	10.3	8.0–12.7	14	10.7	5.4–16.0	NS
Outcome							
Total consultations	2.1	1.2	2.01–2.19	1.8	1.2	1.59–2.01	0.007
LOS in ED (min)	130	83	24–178	111	73	30–156	0.020
ICU admission	43	6.6	4.95–8.84	13	9.9	5.77–16.36	NS
ICU stay (days)	0.9	5.0	0.52–1.28	0.8	3.5	0.2–1.4	NS
Hospitalization (days)	10.1	10.9	9.3–10.9	10.1	7.7	8.8–11.4	NS
Surgical intervention	337	52.0	48.2–55.9	67	51.1	42.6–59.7	NS
In-hospital mortality	60	9.3	7.0–11.5	17	13	7.2–18.7	NS

GCS: Glasgow Coma Scale, ISS: Injury Severity Score, AIS: Abbreviated Injury Scale, MVA: motor vehicle accident, LOS in ED: length of stay in emergency department, ICU: intensive care unit, NS: not significant.

another inpatient bed (141 ± 75 min vs. 130 ± 83 min; P = 0.042). Among patients that were admitted to the ICU, the ED LOS of the older trauma victims was lower compared to the younger adults, but it did not reach significance after adjusting for ISS (87 ± 64 min vs. 153 ± 72 min; P = 0.15).

After adjusting for ISS and total consultations, ED LOS was significantly shorter in the elderly compared to the adults (115 min vs. 132 min; F = 24.2; P < 0.0001).

3.2. Consultations

ED LOS was correlated with the number of consultations (Spearman's r = 0.448, P < 0.0001). Compared to low-impact injuries, high-impact injuries had more consultations in the ED for both the adults and the elderly (2.37 ± 1.32 vs. 1.63 ± 0.86, P < 0.0001 for the adults, and 2.12 ± 1.34 vs. 1.36 ± 0.80, P < 0.0001 for the elderly).

After controlling for ISS, the total number of consultations in the elderly was significantly lower than that of the adults (2.07 ± 1.42 vs. 2.53 ± 1.44; P < 0.0001). The analyses of the ISS-adjusted specific consultation ratios are shown in Table 3. ICU admission did not differ between the age groups (Table 1), but the ISS-adjusted ratio for asking for an anesthesia consultation for ICU

Table 2. Specific trauma diagnoses according to age groups.

	Adult		Elderly	
Diagnosis	% (n)	95% CI	% (n)	95% CI
Scull frx	14.0 (91)	11.37–16.71	10.7 (14)	5.4–15.98
Maxillofacial frx	10.5(68)	8.13–12.85	8.4 (11)	3.65–13.15
Intracranial hemorrhage*	10.8 (70)	8.41–13.19	21.4 (28)	14.35–28.39
Brain contusion	12.8 (83)	10.24–15.38	14.5 (19)	8.47–20.53
Eye trauma	4.3 (28)	2.75–5.89	2.3 (3)	0–4.85
Rib frx	16.1 (104)	13.22–18.88	16.8 (22)	10.39–23.19
Hemo- and/or pneumothorax	15.3 (99)	12.51–18.05	11.5 (15)	6–16.9
Pulmonary contusion	10.2 (66)	7.86–12.52	7.6 (10)	3.08–12.18
Cardiac contusion	1.1 (7)	0.28–1.88	1.5 (2)	0–3.63
Acute abdomen*	22.3 (144)	19.02–25.42	14.5 (19)	8.47–20.53
Retroperitoneal hematoma	4.9 (32)	3.27–6.61	3.1 (4)	0.11–5.99
Kidney injury	2.8 (18)	1.51–4.05	3.8 (5)	0.54–7.1
Splenic injury	4.3 (28)	2.75–5.89	1.5 (2)	0–3.63
Bowel injury*	5.3 (34)	3.53–6.97	1.5 (2)	0–3.63
Liver injury	6.3 (41)	4.46–8.2	6.1 (8)	2.01–10.21
Stomach and/or pancreas injury	1.4 (9)	0.49–2.29	0	0
Pelvic frx and/or disl*	12.5 (81)	9.95–15.05	4.6 (6)	1.0–8.16
Phalanx and/or tarsal frx and/or disl	5.9 (38)	4.05–7.67	3.8 (5)	0.54–7.1
Tibia and/or fibula frx and/or disl	11.9 (77)	9.39–14.37	7.6 (10)	3.08–12.18
Femur frx and/or disl*	10.8 (70)	8.41–13.19	28.2 (37)	20.53–35.95
Humerus frx and/or disl	5.9 (38)	4.05–7.67	3.1 (4)	0.11–5.99
Radius and/or ulna frx and/or disl	7.4 (48)	5.39–9.43	4.6 (6)	1.0–8.16
Scapula frx and/or disl	2.6 (17)	1.39–3.85	3.1 (4)	0.11–5.99
Clavicle frx and/or disl	4.0 (26)	2.5–5.52	6.9 (9)	2.54–11.2
Sternum frx	0.6 (4)	0.02–1.22	0.8 (1)	0–2.25
Cervical vertebra frx and/or disl	3.4 (22)	2.0–4.8	3.8 (5)	0.54–7.1
Thoracal vertebra frx and/or disl*	4.8 (31)	3.14–6.42	9.2 (12)	4.22–14.1
Lumbar vertebra frx and/or disl	7.7 (50)	5.66–9.78	7.6 (10)	3.08–12.18
Vascular injury	5.3 (34)	3.53–6.97	2.3 (3)	0–4.85
Nerve injury	6.2 (40)	4.32–8.02	2.3 (3)	0–4.85

frx: fracture; disl: dislocation. *: statistically significant diagnoses between the 2 age groups.

admission was significantly rare for the elderly compared to the adults (Table 3).

4. Discussion

In this study, the 2 age groups were similar in terms of sex, GCS, ISS, ICU admission, operation ratio, and in-hospital mortality. However, after adjusting for ISS and total consultations, ED LOS was significantly shorter in the elderly when compared to the adults, and after controlling for ISS, the total number of consultations in the elderly was significantly lower than that of the adults.

Covington et al. examined hospital resources using 3 measures: length of hospital stay, length of ICU stay, and total hospital charges billed during the hospitalization. Controlling for injury severity, they found that elderly adults had longer mean hospital and ICU lengths of stay and higher mean hospital charges than the adults or children did (14). McKevitt et al. studied resource use and patient

Table 3. ISS-adjusted consultation ratios according to age groups.

	Adult		Elderly		P-value
Consultation	%	95% CI	%	95% CI	
Neurosurgery	48.5	47.44–49.62	56.7	54.33–59.11	<0.0001
Orthopedics	50.9	49.8–51.98	47.9	45.53–50.35	0.029
Thorax surgery	39.6	38.56–40.68	35.7	33.4–38.02	0.003
General surgery	51.3	50.19–52.37	33.1	30.84–35.38	<0.0001
Anesthesia (ICU)	9.5	8.9–10.18	2.3	1.58–3.02	<0.0001
Cardiovascular surgery	13.8	13.06–14.56	7.1	5.84–8.32	<0.0001
Urology	12.8	12.11–13.57	9.1	7.69–10.47	<0.0001
Plastic and reconstructive surgery	8.9	8.32–9.56	1.3	0.73–1.81	<0.0001
Ophthalmology	5.4	4.87–5.85	3.8	2.89–4.73	0.009
Ear nose throat	6.1	5.6–6.64	5.3	4.25–6.41	0.214

outcomes in adult and elderly severely injured patients. For the whole hospitalization period, the geriatric trauma patients had greater resource requirements per admission (as measured by LOS and the number of consultations) than the younger patients with a similar ISS did (8).

Suboptimal care due to older age may exist in many levels of trauma care. Although there is evidence that elderly patients who have severe injuries have better outcomes when treated at a trauma center (15), injured elderly patients are undertriaged to trauma centers in the preemergency period, despite the increased risk of death and complications (10). Plaisier et al. (16) and, recently, Cooper et al. (17) found at a surgical ICU and in a multicentric study, respectively, that older age was one of the parameters associated with ordering the withdrawal of care in trauma patients. The aforementioned research pointed out the deficiencies in the approach to elder trauma in the pre- and postemergency phases. Our findings showed that in our ED, the resource allocations given to elderly trauma victims and to younger adults were the same.

Geriatric trauma care is different from the trauma care we encounter in younger adults. Older adults are a distinct subgroup, and several important differences between older and younger patients have been shown so far. The difference in trauma mechanisms between the age groups is a well-known entity, in both our region and in the whole world: the most often seen trauma mechanism in the geriatric age group is a ground-level fall, while in the adult age group it is MVA, which is consistent with our results (9).

Our results show a significantly higher incidence of intracranial hemorrhage, femur fracture and/or dislocation, and thoracic vertebra fracture and/or dislocation in elderly patients as compared to adults. Head injuries account for the greatest proportion of major injuries in the elderly (36%–64%), followed by orthopedic injuries (14%–36%) and thoracic trauma (12%–18%) (18). Demetriades et al. found that MVA; injuries to the brain, spine, and thorax; and skeletal injuries increase dramatically with age, although injuries to the abdomen do not (19). Road traffic accidents carry a higher risk of chest injuries and a higher incidence of rib and sternum fractures in the elderly (20). The higher risk of intracranial bleeding was attributed to several factors: decreases in brain weight with age, increases in intracranial free space due to cerebral atrophy, firmer adherence of the veins to the dura, and the use of anticoagulant and antiplatelet medications (21). After wrist fractures, hip fractures are said to be the second most common injury in elderly patients after a fall (22,23). The spinal column in the elderly is exposed to an increased risk of spine fractures due to a number of chronic progressive inflammatory conditions, such as ankylosing spondylitis, rheumatoid arthritis, and functional spinal ankylosis (24). Contrary to our results, previous studies have found that the rate of cervical spine injury was twice as great in geriatric patients as in nongeriatric patients (25,26).

It was reported that the abdomen in the elderly is injured at a rate surprisingly similar to that of younger adults (25). However, in our study, the adult trauma patients suffered significantly more from acute abdomen, bowel injury, and pelvic fracture and/or dislocation compared to the elderly. The high rates of these injuries might well be influenced by the higher incidence of general surgery consultations (ISS-adjusted) in the adults. Abdominal examination should be considered less reliable in elderly patients in nontraumatic conditions, as evidenced by the lack of sensitivity of abdominal examination for surgery (27).

This study contains a single institution's outcomes among a group of older trauma patients. For a more comprehensive understanding of the elderly trauma population, further research using a larger range of patients should be conducted in multiple geographic locations. Factors such as preinjury illness or in-hospital complications were not taken into consideration. There may also have been other uncontrolled factors going on in the ED that may have contributed to the difference in ED LOS between the age groups, such as imaging and laboratory modalities.

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