Original Article

COMPARATIVE ANALYSIS OF THE CHARACTERISTICS OF TRAUMAS SUFFERED BY ELDERLY AND YOUNGER PATIENTS

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ABSTRACT

Objective. To assess the characteristics of traumas suffered by the elderly by comparison with a group of younger trauma victims.

Methods. Trauma protocols from June 10, 2008 to March 9, 2009 were evaluated including all trauma patients above 13 years of age admitted to the emergency room. Data were collected on trauma mechanism, preexisting diseases, vital signs on admission, injuries diagnosed, trauma index scores, tests and treatment. Patients over 60 years were assigned to the elderly group (Group I). Data were compared between this group and a group of younger patients (Group II), using Student's t test, the chi square test and Fisher's exact test, considering $p<0.05$ as significant.

Results. Two thousand and seventy-five trauma victims were recruited (77.1% male), 211 (10.2%) in group I. The most frequent trauma mechanisms in the elderly were falls (from patients' own height) (41%) and being hit by automobiles (28%). Preexisting diseases were more frequent in Group I and included systemic arterial hypertension and diabetes mellitus. The most frequent injuries to Group I patients were to the extremities, affecting 106 patients (50.2%). Fractures were diagnosed in 18% of the elderly patients. In comparison with younger trauma patients, elderly patients had significantly higher head scores on the AIS (0.75 + 1.17 vs. 0.54 + 1.04) ($p=0.014$) and lower thoracic (0.15 + 0.62 vs. 0.26 + 0.86) ($p=0.018$) and abdominal scores (0.05 + 0.43 vs. 0.21 + 0.82) ($p<0.001$). Severe injuries (AIS > 3) to the head were more frequently observed in Group I (11.4% vs. 7%) ($p=0,023$). Certain types of injury were more frequent in Group I: subdural hematomas (2.8% vs. 0.8%) ($p=0.008$), subarachnoid hemorrhages (3.8% vs. 1.3%) ($p=0.005$) and cerebral contusions (5.2% vs. 2.3%) ($p=0.015$).

Conclusion. In comparison to younger trauma victims, the elderly group was characterized by a higher frequency of falls from their own height, concomitant diseases and severe intracranial injuries, including subdural hematoma, cerebral contusions and subarachnoid hemorrhages.

Key words: Multiple trauma. Geriatrics. Accidental falls. Hospital mortality.

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Introduction

Traumatisms among the elderly are an ever-growing problem because of the worldwide increases in longevity[1]. In the United States the elderly population increased by approximately 12% between 1990 and 2000[1]. Brazil has followed the same demographic trend, with an index of population aging of more than 150% for the period from 1960 to 1996[2]. It is estimated that 32 million Brazilians will be 60 years old or more by 2025, which will make them the sixth largest population of elderly people in the world[3].

Geriatric traumas have certain specific characteristics, primarily caused by a reduction in physiological reserves which can affect members of this population, but also

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because of the number of chronic-use medications, because of the diseases with which they are associated, because of the mechanisms of trauma injury and because of the injuries themselves[1,4,5]. These factors mean that mortality is higher than in other age groups, even when comparisons are made with control for severity according to trauma indexes[1,5,6]. Nevertheless, we find that the majority of elderly accident victims have suffered from milder trauma mechanisms, such as falls from their own height. This can lead to assessment errors, delaying diagnosis and treatment in exactly that group of patients for which small errors can create large problems[6].

Trauma centers should consider using specific protocols for monitoring and treating traumatized elderly people[7]. and by so doing identify specific characteristics of elderly trauma victims which can provide information that is important for rapid recognition of at-risk groups, thereby enabling directed work up and early intervention to reduce complications and deaths. The objective of this study was therefore to identify the characteristics of traumas suffered by elderly people by comparing their variables with a group of trauma patients who were not elderly.

Methods

This study was approved by the Research Ethics Committee at the Irmandade da Santa Casa de Misericórdia de São Paulo (protocol 348/09).

Data were collected prospectively on all trauma patients seen at the emergency room of the ISCMSP from June of 2008 onwards. The data collection protocol was initially filled out by surgery residents when the patient was admitted and supplemented by treating physicians until patient discharge. Data collected included patient identification, mechanism of trauma, pre-admission variables, vital signs on admission, trauma index scores, supplementary tests, preexisting diseases, injuries diagnosed and treatment provided.

This study analyzed data from the protocols for all patients aged over 13 years completed between the 10th of June of 2008 and the 9th of March of 2009. All of the variables recorded on more than 90% of the protocols were included in the analysis. The sample was stratified by severity according to the following trauma indexes: the Glasgow Coma Scale (GCS),8 Revised Trauma Score (RTS),9 Abbreviated Injury Scale (AIS)10 and Injury Severity Score (ISS).11 Injuries were defined as severe if the AIS score was greater than or equal to three.

Trauma victims over the age of 60 were considered elderly.12 In order to identify the characteristics of traumas among the elderly, we compared the variables from this group (Group I) with those of all other trauma victims (Group II). Data were input using Microsoft Access and statistical analysis was performed using the Statistical Package for the Social Sciences (16.0). Student's t test, the chi-square test and Fisher's exact test were used to compare the groups and p values smaller than 0.05 were defined as significant.

Results

A total of 2075 trauma victims were enrolled on the study, 77.1% of whom were male. Two hundred and eleven patients (10.2%) were over 60 (Group I). The mean age of Group I was 72.9± 8.8 and mean age in Group II was 33.0± 11.2 years. The percentage of women was higher in group I (41.7% vs. 20.5%) ($p<0.001$) (Table 1).

Table 2 lists the most common trauma mechanisms for each group. Elderly patients were most frequently victims of falls from their own height (41%) e followed by being hit by motor vehicles (28%), whereas motorcycle accidents were the most common cause of trauma in Group II (28%) ($p<0.001$). It was observed that the elderly patients presented with greater frequency systemic arterial hypertension (13.7% vs. 1.1%) ($p<0.001$), diabetes mellitus (4.7% vs. 0.3%) ($p<0.001$) and other preexisting diseases (7.1% vs. 2.5%) ($p<0.001$) (Table 1).

Analysis of pre-admission variables showed that mean systolic blood pressure was significantly greater in Group I (132.21±36.34 mmHg vs. 120.79±24.76 mmHg) ($p=0.001$) (Table 3). At admission, Group I mean systolic pressure was higher (137.07±31.06 mmHg vs. 125.65±22.44 mmHg) ($p<0.001$) and Group I mean heart rate was lower (80.14±14.41 bpm vs. 87.90±14.01 bpm) ($p=0.001$), while no significant differences were detected in mean respiratory rate, Glasgow Coma Scale score or RTS score (Table 3).

Injuries to extremities were observed in 106 Group I patients (50.2%), with 38 patients suffering fractures (18%). Compared with younger trauma patients, the elderly patients had higher mean AIS scores for the head/brain section (0.75±1.17 vs. 0.54±1.04) ($p=0.014$) and lower mean AIS thorax (0.15±0.62 vs. 0.26±0.86) ($p=0.018$) and abdomen scores (0.05±0.43 vs. 0.21±0.82) ($p<0.001$) (Table 3). Furthermore, Group I patients suffered severe injuries (AIS > 3) to the head/brain with greater frequency (11.4% vs. 7%) ($p=0.023$) and severe abdominal injuries with lower frequency (1.4% vs. 4.3 %) ($p=0.025$). Severe injuries to the extremities were more frequent among the elderly patients (18.0% vs. 14.3%) while severe thoracic injuries were less common (3.3% vs. 5.7%), although without achieving statistical significance.

Certain injuries were more common among the elderly patients, including subdural hematomas (2.8% vs. 0.8%) ($p=0.008$), subarachnoid hemorrhages (3.8% vs. 1.3%) ($p=0.005$) and cerebral contusions (5.2% vs. 2.3%) ($p=0.015$) when compared with younger patients (Table 1). Other injuries were significantly less common in Group I, such as pneumothorax (0.5% vs. 3.8%) ($p=0.004$) and hemothorax (0 vs. 3.4%) ($p=0.001$) (Table 1).

Operations such as chest drainage (0.9% vs. 4.7%) ($p=0.004$) and explorative laparotomy (0.9% vs. 4.3%) ($p=0.008$) were performed less frequently on the elderly (Table 1). No differences were observed when mean ISS and mortality were compared between groups.

Discussion

Defining "elderly" is not a simple task[12]. It is believed that assessing functional reserves is the best method for truly

Table 1 - Comparison of variables for Groups I and II

	Group I (n=211)	Group II (n=1864)	p
Female sex	41.7%	20.5%	<0.01
Systemic arterial hypertension	13.7%	1.1%	<0.01
Diabetes mellitus	4.7%	0.3%	<0.01
Other diseases	7.1%	2.5%	<0.01
Subdural hematoma	2.8%	0.8%	<0.01
Subarachnoid hemorrhage	3.8%	1.3%	< 0.01
Cerebral contusion	5.2%	2.3%	0.01
Diffuse axonal injury	0.5%	1%	0.48
Brain Swelling	0.5%	0.7%	0.74
Skull fracture	0.9%	2.1%	0.25
Base of skull fracture	0.5%	2.2%	0.09
Spinal trauma	2.4%	1.4%	0.26
Hemothorax	0	3.4%	< 0.01
Pneumothorax	0.5%	3.8%	< 0.01
Fractured ribs	2.4%	3.9%	0.28
Flaccid chest	0%	1.3%	0.15
Pulmonary contusion	0.9%	2.1%	0.42
Subcutaneous emphysema	0%	1.1%	0.25
Liver	0.5%	1.6%	0.73
Spleen	0.5%	1.7%	0.53
Kidney	0%	0.8%	0.87
Pelvic fractures	1.4%	2.0%	0.79
Upper limb fractures	6.6%	4.8%	0.74
Lower limb fractures	6.6%	4.8%	0.95
Exposed upper limb fractures	1.4%	1.2%	0.34
Exposed lower limb fractures	2.8%	3.4%	0.68
Craniotomy/ craniectomy	2.4%	1.1%	0.12
Chest drainage	0.9%	4.7%	< 0.01
Videothoracoscopy	0%	0.6%	0.61
Thoracotomy	0.5%	0.7%	0.74
Video laparoscopy			
Laparotomy	0.9%	4.3%	< 0.01

Table 2 - Comparison of groups by trauma mechanism

Mechanism	Group I (n=211)	Group II (n=1864)
Wound from sharp or blunt instrument	1.9%	6.1%
Wound from firearm projectile	0.5%	1.9%
Driver/passenger of motor vehicle	5.2%	9.3%
Hit by motor vehicle	28.6%	19.8%
Rider/passenger on motorcycle	2.9%	28.5%
Aggression	4.3%	10.2%
Fall from own height	41.0%	9.9%
Others	2.4%	2.7%

establishing the limitations caused by the aging process[1,12]. As a general rule, in developed countries people over the age of 70 are considered elderly. In developing countries, 65 years is considered to be the limit. However, in countries with tropical climates, in which the ageing process occurs earlier, people over the age of 60 are understood to be elderly, which is the reason why we chose that limit for this study[13].

On the basis of the growth in the elderly population, Mackenzie et al. have estimated that this part of the population will account for around 40% of trauma victims by the middle of the twenty-first century[14]. In our study, around 10% of the trauma patients seen were elderly. We also observed that falls from own height and being hit by motor vehicles were significantly more frequent among the elderly. In developed countries, falls are also the most common trauma mechanism, accounting for around 60% of cases and followed by motor vehicle accidents[1,15,16,17]. It is likely that, in addition to greater susceptibility to falls, this population also has fewer defenses against falling, both because of limitations to movement and because of impaired reflexes and blunted senses. This is associated with well-established risk factors and preventative measures really can reduce the frequency of these events[18,19]. The Brazilian "casa protegida" (protected house) is one proposal for reducing traumatisms among the elderly, as is educating the population about road safety[20].

As was expected, in our study we observed an increased incidence of preexisting diseases such as systemic arterial hypertension, diabetes mellitus and other non-age-related diseases. These diseases and their medications have a direct impact on respiratory and hemodynamic condition, which often masks the severity of the trauma and precipitates hypoperfusion and hypoxia in patients with increased incidence of arterial disease (atherosclerosis). Neideen et al. report an increase in mortality in elderly trauma victims who had previously been on beta-blockers[21]. There is also concern about the growing use of anticoagulants and platelet

Table 3 - Comparison of groups by means + standard deviations for numerical variables

	Group I	Group II	p
Pre-admission systolic blood pressure (mmHg)	132.21 ± 36.34	120.79 ± 24.76	<0.01
Pre-admission respiratory rate (breaths/minute)	18.58 ± 3.88	18.36 ± 4.31	0.61
Pre-admission Glasgow Coma Scale		14.27 ± 2.20	0.47
Systolic blood pressure on admission (mmHg)	137.07 ± 31.06	125.65 ± 22.44	<0.01
Heart rate on admission (bpm)	80.14 ± 14.41	87.9 ± 14.01	<0.01
Respiratory rate on admission (breaths/minute)	17.09 ± 3.85	17.25 ± 4.19	0.61
Glasgow Coma Scale on admission	14.18 ± 2.45	14.24 ± 2.28	0.70
Revised trauma score	7.57 ± 1.10	7.60 ± 1.00	0.58
AIS Head	0.75 ± 1.17	0.54 ± 1.04	< 0.01
AIS Neck	0.04 ± 0.36	0.34 ± 0.35	0.80
AIS Chest	0.15 ± 0.62	0.26 ± 0.86	0.02
AIS Abdomen	0.05 ± 0.43	0.21 ±0.82	< 0.01
AIS Extremities	1.00 ± 1.26	0.94 ± 1.23	0.48
Injury Severity Score	5.21 ± 6.97	5.44 ± 8.71	0.71

bpm: beats per minute

aggregation inhibitors[15]. Ivascu et al. observed increased mortality among head trauma patients who had been on aspirin and clopidogrel. In our study, we observed that the elderly patients presented with intracranial hemorrhagic injuries with greater frequency and that these combined with use of medications that interfere with coagulation and hemostasis can have extremely grave results. This combination of risk factors must be identified and treated rapidly and to achieve this protocols have been proposed including early invasive monitoring for at-risk elderly trauma patients[22].

Mean systolic pressure was higher among the elderly patients, whether measured before admission or at the time of admission. In contrast, mean heart rate at admission was lower. Emergency doctors should always be aware of these characteristics of elderly patients. Hemodynamic response is limited in this population and delays in identifying shock can have serious consequences, such as myocardial infarction, ischemic encephalic vascular accident and secondary neurological damage. Therefore, we must always bear in mind the fact that the definition of arterial hypotension may need to be different for elderly people. Nowadays, more precise markers of tissue hypoperfusion, such as baseline consumption (arterial blood gas analysis) and arterial blood lactate, should be employed when evaluating the elderly[4].

It is believed that the elderly are more prone to suffer more serious injuries in equivalent accidents and are at greater risk of death from injuries of similar severity[1,6]. In our study, we observed that orthopedic injuries and injuries to the extremities are more common among elderly trauma victims. There were significant differences when the severity of injuries were compared between the two groups. In the elderly patients were characterized by higher head/brain injury scores, whereas thoracic and abdominal lesions were more frequent and more severe among young trauma victims. The elderly patients exhibited a significantly higher frequency of severe injuries (>3) in the AIS head/brain section, and also subdural hematomas, subarachnoid hemorrhages and cerebral contusions. This has also been recognized in other studies[6,23].

A more in-depth analysis of this subject must take into consideration the significant differences in the trauma mechanisms between the two groups. More than 40% of the elderly were admitted as a result of falls from their own height, which is a mechanism less likely to cause severe injuries to the thorax and abdomen. In contrast, the most frequent mechanism in Group II was accidents to motorcyclists, with a greater incidence of multisystemic trauma. It is probably these differences in the mechanisms of trauma that explain the location of injuries.

There are also problems with early diagnosis of injuries among the elderly. It is estimated that in around 20% of cases the diagnosis recorded at discharge or autopsy is not the same as the diagnosis made on admission[24]. Mortality reached 59% in one group of patients whose severe injuries

were not diagnosed promptly[24]. It is believed that 32% of deaths of elderly trauma victims were the consequence of avoidable complications[25]. This diagnostic difficulty may be related to the increased number of neurological injuries, which make it difficult to diagnose other injuries, or because of the difficulty that some elderly patients have with expressing themselves[26]. It is important to stress the need to conduct a tertiary assessment of critical trauma patients, with those who have problems with verbalizing their complaints and with those who have neurological sequelae, since in these groups the number of unnoticed injuries increases significantly. Lehmann et al. report that failure to triage correctly can result in significant increases in mortality among elderly patients[6].

In our study it was observed that only a small proportion of elderly trauma victims required some type of operation. The need for procedures such as chest drainage and laparotomies was significantly lower.

We did not identify significant differences between the groups in terms of physiological (RTS) or anatomic (ISS) trauma scales. Using trauma indexes with the geriatric population has its limitations[27]. Among patients over the age of 60, these indexes can be habitually incorrect at predicting mortality, especially when injuries are less severe. Analysis of the mean scores on the physiological and anatomic trauma indexes, in combination with the frequency of injuries, demonstrated low impact traumas in the majority of the elderly patients seen. It is important to point out that this should not reduced the level of care provided to elderly trauma victims[28]. Risk factors for increased mortality among the elderly have been described as admission with systemic arterial hypotension, metabolic acidosis, multiple fractures or head/brain traumas[22]. The elevated mortality in this age group and the problems with treatment described above are an alert to the need for quality control measures[29,30].

General analysis of our data on the characteristics of traumas suffered by the elderly calls attention to the important role of prevention which could have a considerable impact on controlling falls from own height and being hit by motor vehicles. It also demonstrates the need for care with early monitoring of at-risk elderly trauma victims, since their hemodynamic conditions may be masked by preexisting diseases combined with the medications they are taking. Another important point is the frequency of neurological injuries, which less experienced physicians could confuse with an altered state of consciousness related to a patient's age. The increased frequency of intracranial injuries among the elderly combined with chronic use of medications that interfere with hemostasis and coagulation constitute a severe problem within this population. We therefore believe that specific protocols should be developed at each institution dealing with these nuances of caring for elderly trauma victims.

Conclusions

Compared with younger trauma victims, the elderly exhibit the following characteristics: increased frequencies of falls from own height, of preexisting diseases and of severe intracranial injuries, including subdural hematomas, cerebral contusions and subarachnoid hemorrhages.

Conflicts of interest: none

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Artigo recebido: 18/11/09
Aceito para publicação: 08/07/10