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ORIGINAL SCIENTIFIC REPORT

Geriatric Trauma in a High-Volume Trauma Centre in Cape Town: How Do We Compare?

Danyca Shadé Breedt[1] · Elmin Steyn[2]

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Abstract

Background Little is known about the injury profile of older persons from low-and-middle-income countries, such as South Africa, where violence is prevalent. This study aimed to identify common mechanisms of injury (MOI), severity, complications, and outcomes in elderly patients admitted to a referral trauma centre in Cape Town.
Methods A retrospective review was performed of all patients ≥60 years presenting at Tygerberg hospital trauma centre over an eight-month period. Descriptive statistics were computed for all variables of interest, and the relationship between the MOI, injury severity score (ISS), complications, and outcomes were assessed.
Results Of the total 7,635 trauma cases admitted, patients ≥60 years accounted for 4% (n = 275). The most frequent MOI was low falls (58%). Of these 11% of injuries were intentionally inflicted. Among them 35% of the patients experienced complications. The ISS was positively associated with the number of complications ($p < 0.01$). The mortality rate was 6.5%. An ISS of ≥10 was associated with increased mortality ($p < 0.01$). The number of complications was positively associated with mortality ($p < 0.01$).
Conclusions In contrast to high-income countries (HICs), the cohort of elderly patients admitted to the trauma centre made up a relatively small portion of the total admissions. Compared to HICs, intentionally inflicted injuries and preventable MOI were common in our sample, underscoring the importance of addressing causative factors. Notably, the ISS was strongly associated with the number of complications and an ISS ≥10 was associated with mortality, highlighting the utility of the ISS in identifying elderly trauma patients most at risk of negative outcomes.

Introduction

In South Africa (SA), high rates of trauma predominantly affect the youth, yet the geriatric population is not exempt and may be considered "easy victims" by potential perpetrators [1–3]. In addition to inherent challenges of age, such as increased comorbidities and lack of physiological reserve, elderly trauma patients may be further compromised by resource constraints, especially in surge situations where they may not qualify for critical care beds [4]. These factors result in higher rates of preventable complications in an already vulnerable population and may lead to prolonged hospital stay [5–7].

Studies on geriatric cohort from the global north investigated the most frequently encountered mechanisms of injury (MOI), complications, outcomes, and associations with mortality [4, 8–13]. According to the majority of studies, including two conducted in under-resourced countries, "low-energy fall" was the most common MOI in the elderly [14–16]. Notably, Gomberg et al. found that falls in the elderly occurred three times more frequently

✉ Danyca Shadé Breedt
breedtshade@gmail.com

[1] Faculty of Medicine & Health Science, Stellenbosch University, Francie van Zijl Drive, Cape Town, South Africa

[2] Division of Surgery, Stellenbosch University & Tygerberg Hospital, Francie van Zijl Drive, Cape Town, South Africa

than motor vehicle collisions (MVCs), the second most frequently reported MOI [17–20]. The most common complications following trauma in the elderly population are related to infections, which are largely preventable [21]. Compromised compensatory abilities and impaired recovery from severe injuries result in complications and an increased mortality risk [4, 11, 12].

The injury severity score (ISS), originally introduced by Baker et. al., has been widely used to assess trauma severity in trauma populations [22, 23]. In terms of mortality in elderly trauma patients, a high ISS was confirmed as a significant predictor across a number of studies [8, 22–24]. Recent studies have also demonstrated the association of increased age with a higher mortality rate [6, 8, 25]. Elderly trauma patients who survive their injuries may indeed return home and recover to full capacity [8].

Few studies have been conducted on geriatric trauma in low-and-middle-income countries (LMICs). Regional referral hospitals in the South African healthcare system care for large patient populations. Cape Town and the Western Cape province are served by only two public tertiary referral (Level-1 equivalent) trauma centres, providing care to an urban and rural population estimated at over 7-million people [26]. Studies conducted in HICs may not be directly applicable to LMICs such as SA where, although skill and experience are not lacking, there is limited physical resources, large trauma loads, and an unfavorable doctor-patient ratio.

The few studies that have been conducted in under-resourced settings were conducted in countries with lower levels of crime and violence than those evident in Cape Town [11]. Data relevant to an under-resourced, overpopulated, and understaffed South African environment is needed to aid in the provision of equitable care for the injured elderly.

The primary aim of this study was to describe the injury profile (i.e., most common MOI, injury severity (ISS), complications) and outcomes of elderly trauma patients admitted to a South African trauma center. The secondary aim was to assess the relationship between these variables.

Material and methods

Study population

This study was a single-center retrospective chart review. The study population comprised all patients ≥60 years who presented to a tertiary referral trauma unit over an 8-month period (June 2018 to January 2019).

Study setting

The study was conducted at Tygerberg Academic Hospital (TBH), one of only two referral and training (Level-1 equivalent) hospitals in Cape Town, SA. On average, > 1000 injured, high-risk patients pass through TBH's trauma department each month, making it one of the largest trauma referral centres in the country, with a drainage area home to over 6-million people [27].

Definitions

'Elderly/Geriatric' was defined, as per the United Nations' definition, as patients who are ≥60 years of age at the time of admission to the trauma unit [28]. Comorbidities and diagnoses were defined according to the ICD-11 coding for mortality and morbidity [29].

Data collection

Purposeful sampling was employed whereby all eligible patients were identified by 'Date of Birth' as indicated in the trauma register at the triage reception. Identifying information was de-linked from the captured data. The medical records of eligible patients were reviewed to capture data associated with the variables of interest, including age, sex, comorbidities, MOI, anatomical location, and nature of the injuries, the ISS, ICU uptake, complications, length of hospital stay, and outcome (i.e., discharged home, transferred to the step-down facility, in-hospital mortality, patient absconded).

Statistical analysis

Data analysis was conducted using SPSS version 25. Descriptive statistics were computed for demographic and clinical data, presented as mean and standard deviation (SD) for quantitative variables, and counts with associated percentages for categorical variables. Bivariate correlational analysis was conducted to determine the strength and direction of associations between continuous variables. Where applicable, non-parametric tests were used to compare continuous variables between two or more independent groups. The association between two categorical variables was investigated using contingency tables and Pearson's chi-square tests or Fisher's exact tests. An ordinal logistic regression model was used to assess the predictive ability of the ISS score on the number of complications (coded as 0, 1, and 2+).

Survival curves, based on time to death, were estimated using Kaplan–Meier survival curves to compare the number of complications and length of hospital stay. The logrank test was used to compare mortality between groups. A p-value of <0.05 was considered statistically significant.

Results

Patient demographics

Of the total 7635 trauma cases admitted to the centre over the 8-month period, elderly trauma cases accounted for 4% (n = 275). The mean age of the sample was 72 years (SD = 9, range 60–97) and over half the sample was female (157, 57.1%) (see Appendices 1, 2 and 3 for differences across age categories and between sexes).

Injury severity score (ISS) and association with age

The mean ISS for our study sample was 8 (SD = 7, range 1–61). No correlation was found between increasing age and a higher ISS (p = 0.52).

Mechanism of injury (MOI)

Of the total (n = 275), 262 (95.3%) presented with blunt injuries and 13 (4.7%) with penetrating injuries. The most frequent MOI was 'low falls' (57.5%), followed by 'fall from height' (9.8%) and 'motor-vehicle collisions' (MVC) (9.1%) (see Table 1 for the full list of MOIs). Of all the MOIs assessed, only MVC had a significantly higher median ISS ($p < 0.05$).

Notably, of the total injuries, 12% were intentionally inflicted, the majority (75.8%) as a result of 'community assault'. Of the other intentional injuries, 'elderly abuse' accounted for 12.1%, domestic violence 9.1% and self-harm 3%.

Table 1 Most frequent mechanisms of injury

Mechanism of injury	Frequency (n = 275)	Percentage (%)
Low falls	158	57.5
Fall from height	27	9.8
Motor vehicle collision	25	9.1
Community assault	22	8.0
Pedestrian vehicle collision	19	6.9
Stab injuries	6	2.2
Seizure-related injuries	5	1.8
Gunshot wounds	4	1.5
Other	9	3.3

Patient complications and outcomes

The majority of the sample (179/275; 65.1%) did not experience any in-hospital complications. Eighty patients (80/275; 29.1%) experienced at least one complication, and 16/275 (5.8%) experienced at least two complications (see Table 2 for list of complications). Neither age (p = 0.51) nor sex (p = 0.31) was associated with the number of complications. The ISS was positively associated with the number of complications and was found to have a strong predictive value (r = 0.45, $p < 0.01$).

Results of an ordinal logistic regression model that assessed the number of complications (coded 0, 1, 2+) on the ISS demonstrated that the ISS was positively associated with the number of complications ($p < 0.001$), with an odds ratio of 1.13 (95% CI 1.08 to 1.18), adjusted for comorbidities. When the ISS numeric values are reflected in increments of 1–3, 4–9, and $\geq$10, each increment was shown to be associated with a 13% increase in the odds for a greater number of complications.

Twenty-six patients (9.5%) were admitted to the ICU. The mean length of hospital stay was seven days (SD = 7; range 1–55 days), and the mean waiting time to surgery was six days (SD = 4; range 1–21 days). When corrected for mortality, a length of hospital stay of less than 10 days showed good survival rates, however, a length of hospital stay of $\geq$10 days was associated with an increased rate of complications.

Of the total number of patients, 76% were discharged home, 14.9% were transferred to a step-down facility, 6.5% died, and 2.5% absconded from the trauma unit. Age was not associated with mortality (p = 0.18). An ISS $\geq$ 10 was associated with mortality ($p < 0.01$), with 25% of patients with an ISS $\geq$ 10 dying within 10 days after admission. A significant association was evident between the number of complications and mortality ($p < 0.01$) (see Table 3). Of these 38% of patients with $\geq$2 complications were discharged home, compared with 84% of patients with no complications.

Discussion

Demographics

Compared to HICs, where more than 15% of trauma patients are elderly, the cohort of elderly patients admitted to the trauma unit during the study period made up a relatively small portion of the total number of trauma admissions [8, 20, 30–32]. In line with our findings, the few studies conducted in LMICs attributed less than 10% of trauma admissions to the elderly population [33–35].

However, when taking into consideration the short duration of the study, it is notable that although the relative number of elderly trauma admissions is a small proportion of the total, the total reflects a large trauma burden and the actual numbers of elderly injuries are substantial.

The mean age of the study population was younger (about 70 years) than the median age reflected in studies from HICs (about 80 years) but is in keeping with studies conducted in LMICs [2, 8, 33, 36, 37]. Although results in the literature vary, findings from the current study are in agreement with those reporting no correlation between age and complications or mortality [8, 38]. This may reflect the age differences in elderly trauma patients in HICs and LMICs, as studies, which determined a significant correlation between age and mortality reported the strongest correlation in those above 80 years [39].

The study population was further divided into age categories by decade (see Appendices 1 and 2) to allow for meaningful comparisons with HIC and LMIC studies that use different age cut-offs to define "geriatric/elderly" patients.

Despite other studies reporting a preponderance of elderly female patients, just over half of the study's sample was female, implying a relatively even spread among the sexes [20, 30, 35].

Table 2 Most frequent complications

Complications	Frequency (n = 122)	Percentage (%)
Neurological	30	24.6
Nosocomial infection	23	18.9
Haematological	17	13.9
Respiratory/cardiological	12	9.8
Endocrine/metabolic	12	9.8
Psychological	8	6.6
Pressure sores	7	5.7
Ophthalmological	3	2.5
Other	10	8.2

ISS

The mean ISS determined in our cohort was relatively low compared to several studies from HICs [3, 4, 8, 40]. A recent study showed that elderly patients are often undertriaged which could be the case in this study, as there are no elderly specific triage criteria in SA [40, 41]. That said, the ISS is a useful measure of injury severity and a potential indicator of complications and mortality given our findings of a higher ISS being associated with both complications and mortality, in keeping with the available literature [8, 42, 43].

MOI

Our findings in terms of MOIs were similiar to those reported in several studies conducted in HICs [4, 13, 18]. For example, falls resulting in head injuries or neck-of-femur fractures, followed by MVCs, were the most frequent reasons for trauma admissions [14, 30, 32, 36, 37, 40, 44]. That said, intentionally inflicted injuries (due to community assault) and certain preventable MOIs (e.g., fall from height and PVCs) were common in our study, compared to findings from HICs [8, 23, 24, 37]. Studies conducted in LMICs showed similar assault rates to the current study [2, 32, 33, 35]. High assault rates may reflect the high crime rates, limited resources, and the relatively few programs in the public sector aimed at elderly trauma prevention evident in LMICs, such as SA, in contrast to most HICs [1, 45, 46].

Elderly victims of violence are five times more likely to die from their injuries compared to their younger counterparts, underscoring the importance of identifying the causative factors of trauma in the South African elderly population [32]. These factors are often directly related to socioeconomic issues which result in a "revolving door" effect in South African trauma departments. The healthcare system alone cannot successfully address these factors but require governmental prioritization and action.

As geriatric patients are vulnerable to abuse/neglect, healthcare professionals in trauma departments should exercise a high level of suspicion and should intentionally enquire about these issues.

Table 3 Injury severity score in relation to complications and mortality

ISS	Patients n = 275 (%)	Patients with complications n = 96 (%)	Patients who died n = 18 (%)
1–3	42 (15.3)	4 (4.2)	1 (5.6)
4–9	187 (68)	64 (66.7)	5 (27.8)
$\geq$ 10	46 (16.7)	28 (29.2)	12 (66.7)

Patient complications and outcomes

Notably, the ISS was strongly associated with both the number of complications and increased mortality, emphasizing the utility of the ISS in identifying elderly trauma patients most at risk of negative outcomes. An ISS $\geq$ 10 was strongly associated with increased mortality and although not normally considered very high, could be considered a useful predictor of negative outcomes in elderly patients in South African where resources are limited and only the most severely injured patient has access to critical care.

We determined an average length of hospital stay of 7 days which is higher than that reported in studies conducted in HICs and less than that determined in some LMICs [34, 36]. This could largely be due to the fact that SA has an inadequate healthcare staff to patient ratio and lack of resources when compared to HICs but a relatively advanced healthcare system when compared to other LMICs [45]. Nonetheless, the longer length of stay has been shown to lead to higher costs in some LMICs which adds to the existing resource constraints [33, 47]. Neither any one specific pre-exisiting comorbidity nor MOI was significantly associated with a longer length of hospital stay.

The mean waiting time from admission to surgery of 6 days determined in our cohort reflects the extended waiting times of stable elderly patients who require surgical management in South African public hospitals.

The mortality rate determined in the current study was higher than that found in the majority of studies from both HICs and LMICs [30, 31, 33–36]. Serious steps should be taken to optimize the management of elderly trauma patients in the South African context. Some considerations include: taking note of the ISS (even if seemingly low compared to younger patients), enquiring about elderly abuse/neglect, helping to enable a more geriatric-friendly environment, and ensuring timely medical management of elderly trauma patients.

Recommendations

Elderly injury risks are under-reported, under-recognised, and need to be prioritized in the South African setting. The public should be educated about these risks while surveillance strategies and vigilance of healthcare workers in the trauma emergency setting should be improved.

As age and co-morbid diseases were not found to be predictive of mortality, we recommend that the importance of an ISS $\geq$ 10 be noted in elderly trauma patients.

Ideally, special triage systems aimed at improving the accuracy of assessing the severity of injury in the elderly, such as the Fragility Index, should be implemented in South African trauma centres, but the potential value should be weighed up against the availability of resources [48].

Future directions include research pertaining to transport-related injuries, the role of alcohol, and the safety of the household environment in the elderly population. Research relevant to LMICs in sub-Saharan Africa is necessary to establish more accurate baseline data that could be used to inform healthcare policy-making. Given the prediction that the number of elderly patients in SA will outnumber those aged 5 and under by 2040, a shift towards age-specific healthcare will be required in the near future to meet rising demands [49].

Limitations

This was a single-centre retrospective review conducted over a relatively short time period. The retrospective nature of the study has inherent limitations such as the potential for missing data. Findings from this study may not be transferable to elderly trauma patients from other trauma centres in SA as the Western Cape has among the highest rates of gang-related violence and assault in the country [50, 51].

While our study depicted an ISS cut off the value of 10 to be statistically significant, we realize that traditionally the ISS categories are $\leq$8, 9–16, $\leq$25 and >25, however, this did not occur in our patient cohort.

Appendix 1

Demographics and injuries according to age categories.

	Total $n = 275$ (%)	60–69 $n = 125$ (%)	70–79 $n = 80$ (%)	80–89 $n = 55$ (%)	≥90 $n = 15$ (%)	*p*-values
Mean age	72.4	63.8	74.1	83.9	91.5	
Male	118 (42.9)	73 (58.4)	29 (36.3)	12 (21.8)	4 (26.7)	
Female	157 (57.1)	52 (41.6)	51 (63.7)	43 (78.2)	11 (73.3)	
Mean ISS [range]	8 [1–61]	8.4 [1–61]	7.7 [1–32]	7.7 [1–25]	8.3 [3–16]	0.616
Blunt injuries	262 (95.3)	114 (91.2)	79 (98.8)	54 (98.2)	15 (100)	0.059
Penetrating injuries	13 (4.7)	11 (8.8)	1 (1.3)	1 (1.8)	0	0.059
MOI						
Low falls	158 (57.5)	52 (41.6)	53 (66.3)	40 (72.7)	13 (86.7)	<0.001*
Fall from height	27 (9.8)	11 (8.8)	10 (12.5)	5 (9.1)	1 (6.7)	0.842
MVC	25 (9.1)	21 (16.8)	3 (3.8)	1 (1.8)	0	0.001*
Community assault	22 (8.0)	12 (9.6)	4 (5.0)	5 (9.1)	1 (6.7)	0.663
PVC	19 (6.9)	11 (8.8)	5 (6.3)	3 (5.5)	0	0.731
Stab injuries	6 (2.2)	6 (4.8)	0	0	0	0.109
Seizure-related injuries	5 (1.8)	4 (3.2)	1 (1.3)	0	0	0.630
Gunshot wounds	4 (1.5)	3 (2.4)	1 (1.3)	0	0	0.854
Other	9 (3.3)	5 (4.0)	3 (3.8)	1 (1.8)	0	0.895
Intentional injuries	33 (12.0)	21 (16.8)	5 (6.3)	6 (10.9)	1 (6.7)	0.140

Injury severity score (ISS), Mechanism of injury (MOI), Motor vehicle collision (MVC), Pedestrian vehicle collision (PVC)

*Significant value

Appendix 2

Complications and outcomes according to age categories.

	Total $n = 275$ (%)	60–69 $n = 125$ (%)	70–79 $n = 80$ (%)	80–89 $n = 55$ (%)	≥90 $n = 15$ (%)	*p*-values
Patients with 1 complication	80 (29.1)	32 (25.6)	23 (28.7)	17 (30.9)	8 (53.3)	0.177
Patients with ≥2 complications	16 (5.8)	9 (7.2)	5 (6.3)	2 (3.6)	0	0.781
Complications						
Nosocomial infection	23 (8.4)	15 (12.0)	4 (5.0)	4 (7.3)	0	0.483
Neurological	30 (10.9)	17 (13.6)	8 (10.0)	3 (5.5)	2 (13.3)	0.392
Respiratory/cardiological	12 (4.4)	6 (4.8)	1 (1.3)	2 (3.6)	3 (20.0)	0.030*
Hematological	17 (6.2)	5 (4.0)	4 (5.0)	5 (9.1)	3 (20.0)	0.045*
Endocrine/metabolic	12 (4.4)	3 (2.4)	6 (7.5)	3 (5.5)	0	0.325
Pressure sores	7 (2.5)	2 (1.6)	3 (3.8)	2 (3.6)	0	0.689
Psychological	8 (2.9)	3 (2.4)	4 (5.0)	1 (1.8)	0	0.731
Ophthalmological	3 (1.1)	3 (2.4)	0	0	0	0.419
Other	10 (3.6)	6 (4.8)	3 (3.8)	1 (1.8)	0	0.923
Discharged from hospital	41 (14.9)	20 (16.0)	16 (20.0)	3 (5.5)	2 (13.3)	0.100
Discharged home	209 (76.0)	96 (76.8)	56 (70.0)	48 (87.3)	9 (60.0)	0.047*
Died	18 (6.5)	7 (5.6)	5 (6.3)	3 (5.5)	3 (20.0)	0.232
Absconded	7 (2.5)	2 (1.6)	3 (3.8)	1 (1.8)	1 (6.7)	0.367

*Significant value

Appendix 3

Results according to sex.

	Total n = 275 (%)	Male n = 118 (%)	Female n = 157 (%)	p-values
Mean age [SD]	72.4 [9.0]	69.0 [8.0]	74.9 [9.6]	0.004*
Mean ISS [range]	8.0 [1–61]	8.6 [1–43]	7.7 [1–61]	0.233
Blunt injuries	262 (95.3)	107 (90.68)	155 (98.73)	0.002*
Penetrating injuries	13 (4.7)	11 (9.32)	2 (1.27)	0.002*
MOI				
Low falls	158 (57.5)	44 (37.3)	114 (72.6)	<0.001*
Fall from height	27 (9.8)	16 (13.6)	11 (7.0)	0.071
Motor vehicle collision	25 (9.1)	15 (12.7)	10 (6.4)	0.070
Community assault	22 (8.0)	17 (14.4)	5 (3.2)	0.001*
Pedestrian vehicle collision	19 (6.9)	10 (8.5)	9 (5.7)	0.375
Stab injuries	6 (2.2)	6 (5.1)	0	0.006*
Seizure-related injuries	5 (1.8)	2 (1.7)	3 (1.9)	1.000
Gunshot wounds	4 (1.5)	4 (3.4)	0	0.033*
Other	9 (3.3)	4 (3.4)	5 (3.2)	0.925
Intentional injuries	33 (12.0)	27 (22.9)	6 (3.8)	<0.001*
Patients with at least 1 complication	80 (29.1)	40 (33.9)	40 (25.5)	0.128
Patients with ≥2 complications	16 (5.8)	6 (5.1)	10 (6.4)	0.652
Complications				
Nosocomial infection	23 (8.4)	12 (10.2)	11 (7.0)	0.388
Neurological	30 (10.9)	15 (12.7)	15 (9.6)	0.406
Respiratory/cardiological	12 (4.4)	6 (5.1)	6 (3.8)	0.612
Haematological	17 (6.2)	8 (6.8)	9 (5.7)	0.944
Endocrine/metabolic	12 (4.4)	5 (4.2)	7 (4.5)	0.929
Pressure sores	7 (2.5)	2 (1.7)	5 (3.2)	0.702
Psychological	8 (2.9)	4 (3.4)	4 (2.5)	0.728
Ophthalmological	3 (1.1)	2 (1.7)	1 (0.6)	0.579
Other	10 (3.6)	7 (5.9)	3 (1.9)	0.123
Discharged from hospital	41 (14.9)	24 (20.3)	17 (10.8)	0.028*
Discharged home	209 (76.0)	79 (66.9)	130 (82.8)	0.002*
Died	18 (6.5)	11 (9.3)	7 (4.5)	0.107
Absconded	7 (2.5)	4 (3.4)	3 (1.9)	0.467

Injury severity score (ISS), Mechanism of injury (MOI), Motor vehicle collision (MVC), Pedestrian vehicle collision (PVC)

*Significant value

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This study was approved by the Institutional Review Board of Tygerberg Hospital and the Undergraduate Research Ethics Committee of Stellenbosch University (no. U19/01/007) and was performed in accordance with the ethical standards described in the Declaration of Helsinki and its later amendments.

Informed consent A waiver of consent was obtained from the Institutional Review Board of Tygerberg Hospital and the Undergraduate Research Ethics Committee of Stellenbosch University.

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