IMJ Official Journal of the Irish Medical Organisation

Ir Med J; May 2024; Vol 117; No. 5; P960
23rd May, 2024

Major trauma in Older Adults: a retrospective analysis of the Major Trauma Audit

K. Junker[1,2,] C. Deasy[1], C. O'Tuathaigh[1], A. Jacques[3].

1. School of Medicine and Health, University College Cork, Co. Cork, Ireland.
2. Department of Geriatric Medicine, Fiona Stanley Hospital, Perth, Western Australia.
3. Institute for Health Research, The University of Notre Dame, Fremantle, Western Australia.

Abstract

Aim

The population of older adults (aged sixty five years or more) is growing. All aspects of healthcare must turn their focus to the older adult. Major trauma is one such area. The aim of this study was to explore major trauma in older Irish adults and describe the associated demographics and injury characteristics.

Methods

This is a retrospective analysis of the Major Trauma Audit. Patients with major trauma who presented to a single centre in Ireland between 1st of January 2016 and 31st of December 2020 were identified. Major trauma is defined using an Injury Severity Score (ISS) of ≥15. Presentation rates were compared between groups using one-sample binomial tests. Logistic regression analysis was used to examine associations between injury and outcome.

Results

1,123 cases were included. 659 (58.7%) were younger adults and 464 (41.3%) were older adults. In those aged seventy five years or more, 147 (the majority) were female (51.6%, p= <0.001). 233 (81.8%) injuries in those aged seventy five years or older (p=<0.001) were due to low falls.

Discussion

Major trauma in older Irish adults places a significant burden on the healthcare system. Older adults should be considered an at risk population. Major trauma in older Irish adults is predominantly due to low falls and is more common in older females.

Introduction

IMJ Official Journal of the Irish Medical Organisation

Ir Med J; May 2024; Vol 117; No. 5; P961
23rd May, 2024

The world's population is rapidly ageing and the population of older adults (age sixty five years or more) is predicted to increase from 841 million in 2013 to over 2 billion by 2050 [1]. According to the Central Statistics Office (CSO), in 2016, the population over sixty five years in Ireland was 629,800. This will increase to 1.6 million by 2051 [2]. As the population ages, life expectancies will rise. Healthcare must focus more on the older adult.

Major trauma refers to serious and multiple injuries and is a leading cause of death and disability worldwide. Causes of major trauma include falls, road traffic accidents (RTA), burns, and penetrating or blunt trauma. Falls may be high falls (from a height greater than two metres) or low falls (from a height less than two metres). Falls and road traffic accidents are the most common causes of major trauma in older adults [3, 4]. Older adults disproportionally present with falls from low heights [4-10].

In the past, major trauma was regarded as a disease of the young [11]. One study demonstrated that in 1990 the mean age of major trauma patients in the UK was 36.1 years and the largest group presenting was aged zero to twenty four years [11]. The same study found an increase in mean age to 53.8 years in 2013 [11]. Similar research estimated that by 2021 older adults would make up 50% of those severely injured [12]. The literature has shown an increasing incidence of major trauma in older adults [3, 4, 6, 8, 11, 13-18].

The population continues to age and with the advantage of increased length of life comes challenges to our healthcare system. Major trauma in older adults is a public health issue. The aims of this study were to determine the prevalence of major trauma in older Irish adults and describe demographics and injuries sustained by this group.

Methods

Patients with major trauma who presented to a single centre in Cork, Ireland between 1st of January 2016 and 31st of December 2020 were identified from Major Trauma Audit (MTA) data. Major trauma is defined using the Injury Severity Score (ISS). ISS of ≥15 is indicative of major trauma.

Cork University Hospital (CUH) is the largest hospital in Ireland and the only Model 4 (Academic teaching hospital) in the state. It is a tertiary centre serving a total population of over 1.1 million in the Health Service Executive (HSE) Southern area and supra regional area of Limerick, Kerry, Tipperary, Waterford and Kilkenny, seeing over 68,000 patients per year.

Using the Trauma Audit and Research Network (TARN) methodology (described in detail elsewhere [19]), the MTA prospectively gathers data on patient care and outcomes following trauma from hospitals across Ireland. TARN is the largest trauma database in Europe and has been gathering data from injured patients in Ireland and the UK since the 1990s. The Major Trauma Audit was

implemented in Ireland in 2013 by the National Office of Clinical Audit (NOCA). TARN includes all those severely injured patients with a length of hospital stay of seventy two hours or more, severely injured patients who are admitted to a high dependency unit regardless of length of stay, and patients who die as a result of severe injuries in the hospital or in the emergency department. Inter-hospital transfers are also included. TARN collects information on patient demographics, prehospital care, emergency department and critical care as well as the patient's continued hospital journey and outcomes.

For the purposes of this study, the following variables were included for analysis; sex (male or female), mechanism of injury, injury severity score, Glasgow Coma Scale (GCS), NICE head injury criteria, presence of shock, most severely injured body region, and year of injury.

Once exclusion criteria were applied (ISS <15, death prior to reaching hospital), data was then divided into groups according to age. Older people were defined as those aged sixty five years or more. Data was analysed according to age in the following groups; age less than sixty five years, age sixty five to seventy four years, and age seventy five years or older.

Descriptive summaries of patient demographic and clinical characteristics consist of medians and interquartile ranges for continuous data and frequency distributions (n, %) for categorical data. Data were grouped by age category, year, and outcome category. Univariate group comparisons of continuous data were done using Mann-Whitney U or Kruskall-Wallace H tests and Chi squared tests were used for categorical group comparisons. Results were summarised using medians and 95% confidence intervals (CI). Presentation rates were compared between groups using one-sample binomial tests. Logistic regression models were implemented to examine associations of injury predictors with mortality outcomes. Results were summarised using odds ratios and 95% CI. Data was analysed using Stata version 18 (StataCorp, College Station, TX). Analysis was two-sided and o-values <0.05 were considered statistically significant.

Ethical approval was obtained from the Clinical Research Ethics Committee (CREC) at University College Cork (UCC) (CREC Review Reference Number: ECM 4 (b) 22/02/2022).

Results

From January 2016 to December 2020 the MTA collected data on 3,144 cases of trauma in CUH. Of these, 1,123 fit the criteria for major trauma (ISS ≥ 15) and were included for analysis.

Within the sample, 659 (58.7%) were younger adults and 464 (41.3%) were older adults. Age demographics did not change over the five year study period. In those aged less than sixty five years, the majority were male (n=488, 74.1%, p = <0.001). In those aged sixty five to seventy four years 122

were male (68.2%) compared with those aged seventy five years or more where the majority were female (n=147, 51.6%, p= <0.001).

The most common mechanism of injury in older adults was low falls. 111 injuries (62%) in those aged sixty five to seventy four years were attributable to low falls compared with 233 (81.8%) injuries in those aged seventy five years or older (p=<0.001). In younger adults RTA remained the most common mechanism of injury (n=222, 33.7%, p=< 0.001). Major trauma in those seventy five years or older was caused by road traffic accidents in just 22 cases (7.7%, p= <0.001). Injuries from falls greater than two metres reduced with age and accounted for 30 (16.8%) injuries in those aged sixty five to seventy four years and only 21 (7.4%) injuries in those aged seventy five years or older (p=<0.001).

The median injury severity score (ISS) in younger adults was 25 (Q1,Q3 = 18.0, 29.0, p= <0.001). In those aged seventy five years or more the median ISS was 22 (Q1,Q3 = 17.0, 26.0, p= <0.001). With regards GCS, younger adults had a lower median GCS of 14 (Q1,Q3 = 11.0, 15.0, p= <0.001). Those aged greater than sixty five years had a median GCS of 15 (p= <0.001).

105 (15.9%) of those aged less than sixty five years (p = 0.46) and 52 (18.2%) of those seventy five years or older (p = 0.46) were NICE head injury criteria positive and mandated the need for a CT brain scan within 1 hour of arrival. The presence of shock did not vary with age; in younger adults 143 (21.7%) were shocked at presentation (p = 0.78) while 38 (21.2%) of those aged sixty five to seventy four years were shocked and 56 (19.6%) of those aged seventy five years or more (p = 0.78).

In all age groups the most severely injured body region was the head. 149 (52.3%) of those aged seventy five years or more had a head injury (p= 0.54). Limb injury was highest in those aged seventy five years or more (n= 26, 9.1%, p = 0.54).

Table 1: Injury and patient specific characteristics

Variable	**Age group**			
	<65 years (N = 659)	65-74 years (N = 179)	≥75 years (N = 285)	p-value
Age				<0.001
Median (Q1, Q3)	38.5 (24.8, 52.2)	70.4 (67.3, 72.8)	82.6 (78.5, 86.9)	
Min, Max	0.1, 64.9	65.0, 74.9	75.0, 102.4	
Sex				<0.001
Male	488 (74.1%)	122 (68.2%)	138 (48.4%)	
Female	171 (25.9%)	57 (31.8%)	147 (51.6%)	

Variable	Age group			
	<65 years (N = 659)	65-74 years (N = 179)	≥75 years (N = 285)	p-value
Mechanism of injury				<0.001
Fall <2m	176 (26.7%)	111 (62.0%)	233 (81.8%)	
Fall >2m	120 (18.2%)	30 (16.8%)	21 (7.4%)	
Vehicle incident/ collision	222 (33.7%)	22 (12.3%)	22 (7.7%)	
Other	141 (21.4%)	16 (8.9%)	9 (3.2%)	
Most severely injured body region				0.54
Head	361 (54.8%)	100 (55.9%)	149 (52.3%)	
Chest	114 (17.3%)	27 (15.1%)	47 (16.5%)	
Limbs	49 (7.4%)	12 (6.7%)	26 (9.1%)	
Abdo	16 (2.4%)	6 (3.4%)	15 (5.3%)	
Other (including spine)	119 (18.1%)	34 (19.0%)	48 (16.8%)	
Year				0.36
2016 – 2017	134 (20.4%)	30 (16.8%)	59 (20.7%)	
2017 – 2018	119 (18.1%)	45 (25.1%)	57 (20.0%)	
2018 – 2019	146 (22.2%)	37 (20.7%)	68 (23.9%)	
2019 – 2020	125 (19.0%)	33 (18.4%)	59 (20.7%)	
2020 – 2021	133 (20.2%)	34 (19.0%)	42 (14.7%)	
NICE Head Injury Criteria met	105 (15.9%)	25 (14.0%)	52 (18.2%)	0.46
Shock (SBP < 110)	143 (21.7%)	38 (21.2%)	56 (19.6%)	0.78
ISS				<0.001
Median	25.0	25.0	22.0	
GCS				<0.001
Median	14.0	15.0	15.0	

Number and % are shown for variables. Head injury criteria refers to NICE head injury criteria being met. Shock refers to systolic blood pressure <110 mmHg at presentation.

In 2016, of those who presented with major trauma, 134 (60.1%) were aged less than sixty five years (p = 0.36), 30 (13.5%) were aged sixty five to seventy four years (p= 0.36), and 59 (26.5%) were aged seventy five years or older. Of older adults presenting with major trauma across the 5 year period (n=464), the fewest presentations were in 2020.

There were no statistically significant variations in sex of patients with major trauma over the five year period.

Falls of less than two metres were the most common mechanism of injury across all five years and the head was the most severely injured body region across all five years.

Ir Med J; May 2024; Vol 117; No. 5; P961
23rd May, 2024

Table 2: Year by year analysis

Variable	**Year**					
	2016 – 2017	***2017 – 2018***	***2018 – 2019***	***2019 – 2020***	***2020 – 2021***	
	(N = 223)	(N = 221)	(N = 251)	(N = 217)	(N = 209)	p-value
Age						0.329
Median (Q1, Q3)	56.4 (34.7, 75.5)	61.9 (37.4, 75.7)	56.8 (33.4, 75.8)	60.2 (37.3, 76.5)	52.2 (31.6, 72.8)	
Min, Max	0.1, 102.4	0.2, 94.9	4.1, 100.0	5.5, 96.1	0.2, 97.5	
Age group						0.364
<65 years	134 (60.1%)	119 (53.8%)	146 (58.2%)	125 (57.6%)	133 (63.6%)	
65-74 years	30 (13.5%)	45 (20.4%)	37 (14.7%)	33 (15.2%)	34 (16.3%)	
>=75 years	59 (26.5%)	57 (25.8%)	68 (27.1%)	59 (27.2%)	42 (20.1%)	
Sex						0.419
Male	140 (62.8%)	157 (71.0%)	163 (64.9%)	144 (66.4%)	142 (67.9%)	
Female	83 (37.2%)	64 (29.0%)	88 (35.1%)	73 (33.6%)	67 (32.1%)	
Mechanism of injury						0.968
Fall <2m	106 (47.5%)	106 (48.0%)	116 (46.2%)	100 (46.1%)	91 (43.5%)	
Fall >2m	30 (13.5%)	33 (14.9%)	37 (14.7%)	30 (13.8%)	41 (19.6%)	
Vehicle incident/ collision	55 (24.7%)	49 (22.2%)	61 (24.3%)	54 (24.9%)	47 (22.5%)	
Other	32 (14.3%)	33 (14.9%)	37 (14.7%)	33 (15.2%)	30 (14.4%)	
Most severely injured body region						0.541
Head	133 (59.6%)	116 (52.5%)	135 (53.8%)	120 (55.3%)	106 (50.7%)	
Chest	32 (14.3%)	44 (19.9%)	38 (15.1%)	37 (17.1%)	37 (17.7%)	
Limbs	7 (3.1%)	21 (9.5%)	24 (9.6%)	16 (7.4%)	19 (9.1%)	
Abdo	7 (3.1%)	6 (2.7%)	9 (3.6%)	7 (3.2%)	7 (3.3%)	
Other (including spine)	44 (19.7%)	34 (15.4%)	45 (17.9%)	37 (17.1%)	40 (19.1%)	
NICE Head Injury Criteria met	42 (18.8%)	40 (18.1%)	34 (13.5%)	29 (13.4%)	36 (17.2%)	0.344
Shock (SBP < 90)	49 (22.0%)	40 (18.1%)	59 (23.5%)	50 (23.0%)	39 (18.7%)	0.493
ISS						0.135
Median	22.0	25.0	25.0	25.0	25.0	

Variable	Year					
	2016 – 2017	***2017 – 2018***	***2018 – 2019***	***2019 – 2020***	***2020 – 2021***	
	(N = 223)	(N = 221)	(N = 251)	(N = 217)	(N = 209)	p-value
GCS						0.717
Median	15.0	15.0	15.0	15.0	15.0	

Note two subjects did not have year of presentation provided in the dataset meaning that two values were missing. Thus for year by year analysis the size of the sample is 1121. Number and % are shown for variables. Numbers and percentages may vary as some variables have missing values. Head injury criteria refers to NICE head injury criteria for CT brain being met. Shock refers to systolic blood pressure <90 mmHg at presentation.

Logistic regression analysis was used to determine what relationships if any exist between injury specific characteristics (mechanism of injury, most severely injured body region, NICE head injury criteria, GCS, ISS) and mortality in this cohort. As detailed in Table 3, those fulfilling the NICE head injury criteria were more likely to die (OR 2.27, 95% CI 1.56 – 3.29, p = <0.001). There were no other statistically significant associations made.

Table 3: Logistic Regression Analysis

Predictor	**Odds ratio (95%CI)**	**p-value**
Injury mechanism		
Fall <2m (reference)	1.00	
Fall >2m	1.13 (0.68,1.88)	0.647
Vehicle Incident/ Collision	1.21 (0.78,1.86)	0.390
Other	1.41 (0.86,2.30)	0.169
Most severely injured body region		
Head (reference)	1.00	
Chest	0.24 (0.12,0.48)	<0.001
Limbs	0.23 (0.08,0.63)	0.005
Abdomen	0.27 (0.06,1.13)	0.074
Other	0.79 (0.51,1.24)	0.306
Head Injury	2.27 (1.56,3.29)	<0.001
Shock	1.01 (0.66,1.53)	0.977
GCS	0.97 (0.93,1.02)	0.199
ISS	1.01 (0.99,1.03)	0.540

Logistic regression analysis exploring relationships between injury characteristics and mortality.

Discussion

Major trauma in older Irish adults places a significant burden on our healthcare system. Over the five year period, 41% of major trauma presentations were in those aged sixty five years or more. Low falls were the most common cause of major trauma.

Of the 1,123 cases of major trauma (ISS>15) identified over five years, 464 (41.3%) were older adults. This reduction in major trauma presentations in 2020 associated with Covid lock downs is well documented throughout the literature. A retrospective review of major trauma cases recorded in the UK TARN database from 1990 to 2013 showed that the mean age of those presenting with major trauma was increasing over time. A similar study carried out in Australia explored a trauma registry from 2007 to 2016; the number of older adults presenting with major trauma doubled within the study period [4]. Another Australian study conducted in a single centre in Sydney between 1991 and 2010 found that the proportion of older adults presenting with major trauma was steadily increasing by 4.9% per year and accounting for approximately one third of all major trauma presentations [20]. In Taiwan between 2003 and 2015 the incidence rate of major trauma in older adults was approximately two to three times that of all other age groups [21]. The above studies are longitudinal and focus on time periods in which prevention and management of trauma changed significantly.

The percentage of females with major trauma increased with age such that in those aged seventy five years or older, the majority were female (51.6%, p=<0.001). The Major Trauma Audit National Report (2019-2020) in Ireland also found that major trauma was a disease of young males and older females [22]. The female cohort are more predisposed to osteoporosis versus their male counterparts and this had a significant impact on the prevalence of fractures and higher injury severity scores in this group [23].

Falls less than two metres were the most common cause of injury; 46.3% of all presentations (n=520) over the five year period were as a result of low falls; in the UK and Australia findings have been similar [4, 11]. In those aged sixty five to seventy four years 61% of traumas were caused by a low fall; in those aged seventy five years or more 81.8% of major trauma presentations were caused by low falls and just 7.7% of presentations were due to RTAs. This demonstrates an increase in low falls with age. An abundance of prior research has shown that older adults disproportionally present with falls from low heights [4-9].

This study found that older adults present with a median ISS lower than that of their younger counterparts (22 compared with 25, p=<0.001). With regards GCS, younger adults had a lower median of 14 (p=<0.001) while those aged sixty five years or more had a median GCS of 15 (p=<0.001). Older adults often present with a higher Glasgow Coma Scale (GCS) than younger adults for the same severity of intracranial injury [6, 11, 16] because of brain atrophy allowing greater room for expansion of a cerebral hematoma or cerebral oedema before it becoming clinically apparent; this

creates diagnostic and management challenges [24]. The head was the most severely injured body region in those aged seventy five years or more (52.3%). Limb injury was highest in those aged seventy five years or more which is not unsurprising given the rate of low falls in this cohort. In this cohort, those with a head injury were more likely to die (OR 2.27, p=<0.001).

Recently, the health service has been focusing care more on the older adult. In the HSE publication "making a start in Integrated Care for Older Persons" they outline a ten step framework towards implementing age specific care in Ireland [25].

This study demonstrates the impact of major trauma on older Irish adults presenting to a major trauma centre. Older adults should be considered an at risk population with regards major trauma. Low falls are the most common cause of major trauma in older Irish adults. Major trauma is more common in older females. A multiagency societal approach to the reduction of low falls in the home is required to address the current presentations of major trauma in older Irish adults.

Declarations of Conflicts of Interest:
None declared.

Corresponding author:
Kate Junker,
School of Medicine and Health,
University College Cork,
Co. Cork,
Ireland.
E-Mail: junkerkate0@gmail.com

References:

1. Chatterji S, Byles J, Cutler D, Seeman T, Verdes E. Health, functioning, and disability in older adults—present status and future implications. The lancet. 2015;385(9967):563-75.
2. CSO. Population and Labour Force Projections 2017-2051. Central Statistics Office; 2017.
3. Sammy I, Lecky F, Sutton A, Leaviss J, O'Cathain A. Factors affecting mortality in older trauma patients-A systematic review and meta-analysis. Injury. 2016;47(6):1170-83.
4. Beck B, Cameron P, Lowthian J, Fitzgerald M, Judson R, Gabbe B. Major trauma in older persons. BJS open. 2018;2(5):310-8.

5. Walsh ME, Ferris H, Coughlan T, Hurson C, Ahern E, Sorensen J, et al. Trends in hip fracture care in the Republic of Ireland from 2013 to 2018: results from the Irish Hip Fracture Database. Osteoporosis International. 2021;32(4):727-36.
6. Fisher JM, Bates C, Banerjee J. The growing challenge of major trauma in older people: a role for comprehensive geriatric assessment? Age and ageing. 2017;46(5):709-12.
7. Lesko K, Deasy C. Low falls causing major injury: a retrospective study. Irish journal of medical science. 2020:1-9.
8. Dixon JR, Lecky F, Bouamra O, Dixon P, Wilson F, Edwards A, et al. Age and the distribution of major injury across a national trauma system. Age and ageing. 2020;49(2):218-26.
9. Herron J, Hutchinson R, Lecky F, Bouamra O, Edwards A, Woodford M, et al. The impact of age on major orthopaedic trauma: an analysis of the United Kingdom Trauma Audit Research Network database. The bone & joint journal. 2017;99(12):1677-80.
10. Ziegenhain F, Scherer J, Kalbas Y, Neuhaus V, Lefering R, Teuben M, et al. Age-Dependent Patient and Trauma Characteristics and Hospital Resource Requirements—Can Improvement Be Made? An Analysis from the German Trauma Registry. Medicina. 2021;57(4):330.
11. Kehoe A, Smith J, Edwards A, Yates D, Lecky F. The changing face of major trauma in the UK. Emergency medicine journal. 2015;32(12):911-5.
12. Spering C, Lefering R, Bouillon B, Lehmann W, von Eckardstein K, Dresing K, et al. It is time for a change in the management of elderly severely injured patients! An analysis of 126,015 patients from the TraumaRegister DGU®. European journal of trauma and emergency surgery. 2020;46(3):487-97.
13. Conroy SP, Turpin S. New horizons: urgent care for older people with frailty. Age and ageing. 2016;45(5):577-84.
14. Carpenter CR, Shelton E, Fowler S, Suffoletto B, Platts-Mills TF, Rothman RE, et al. Risk factors and screening instruments to predict adverse outcomes for undifferentiated older emergency department patients: a systematic review and meta-analysis. Academic Emergency Medicine. 2015;22(1):1-21.
15. Moran CG, Lecky F, Bouamra O, Lawrence T, Edwards A, Woodford M, et al. Changing the system-major trauma patients and their outcomes in the NHS (England) 2008–17. EClinicalMedicine. 2018;2:13-21.
16. Kehoe A, Smith J, Bouamra O, Edwards A, Yates D, Lecky F. Older patients with traumatic brain injury present with a higher GCS score than younger patients for a given severity of injury. Emergency medicine journal. 2016;33(6):381-5.
17. Ichwan B, Darbha S, Shah MN, Thompson L, Evans DC, Boulger CT, et al. Geriatric-specific triage criteria are more sensitive than standard adult criteria in identifying need for trauma center care in injured older adults. Annals of emergency medicine. 2015;65(1):92-100. e3.
18. Savioli G, Ceresa IF, Macedonio S, Gerosa S, Belliato M, Luzzi S, et al. Major trauma in elderly patients: Worse mortality and outcomes in an Italian Trauma Center. Journal of Emergencies, Trauma, and Shock. 2021;14(2):98.

19. Deasy C, Cronin M, Cahill F, Geary U, Houlihan P, Woodford M, et al. Implementing Major Trauma Audit in Ireland. Injury. 2016;47(1):166-72.
20. Dinh MM, Roncal S, Byrne CM, Petchell J. Growing trend in older patients with severe injuries: mortality and mechanisms of injury between 1991 and 2010 at an inner city major trauma centre. ANZ journal of surgery. 2013;83(1-2):65-9.
21. Lee IY, Shih C-Y, Wei Y-T, Weng T-C, Shieh S-J, Wang J-D. Increasing burden of major trauma in elderly adults during 2003–2015: Analysis of real-world data from Taiwan. Journal of the Formosan Medical Association. 2022;121(1, Part 1):144-51.
22. Audit NOoC. Major Trauma Audit: National Report 2019 and 2020. Dublin: National Office of Clinical Audit; 2022.
23. Gioffrè-Florio M, Murabito LM, Visalli C, Pergolizzi FP, Famà F. Trauma in elderly patients: a study of prevalence, comorbidities and gender differences. G Chir. 2018;39(1):35-40.
24. Dixon J, Bouamra O, Lecky F, Hing CB, Baxter M, Eardley W. Regional variation in the provision of major trauma services for the older injured patient. Injury. 2022;53(7):2470-7.
25. Executive HS. Making a start in Integrated Care for Older Persons. Health Service Executive; 2023.