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Herron, J., Hutchinson, R., Lecky, F. et al. (4 more authors) (2017) The impact of age on major orthopaedic trauma: an analysis of the United Kingdom Trauma Audit Research Network database. Bone and Joint Journal, 99-B (12). pp. 1677-1680. ISSN 2049-4394

https://doi.org/10.1302/0301-620X.99B12.BJJ-2016-1140.R2

The impact of age on major orthopaedic trauma in the United Kingdom

A themed analysis of the Trauma Audit Research Network Database

Aim

To compare the early management and mortality of older patients with major orthopaedic trauma with that of a younger population with similar injuries.

Methods

The Trauma Audit and Research Network database was interrogated to identify cases admitted between April 2012 and June 2015. Injury distribution and severity, interventions, comorbidity, critical care episodes and mortality were recorded.

Results

Of 142,765 adults with major trauma, 72,942 (51.09 %) had long bone or pelvic fractures and 45.81% of these were >64 years old. Road traffic collision was commonest mechanism in the young (40.4%) and in older people, fall from standing height (80.4%). Mortality in older patients with fractures is greater (6.8 vs 2.5%), although critical care episodes are more common in the young (18.2 vs 9.7%). Orthopaedics is the commonest admitting and operating speciality and in older people, fracture surgery accounted for 82.1% of procedures.

Conclusion

Orthopaedic trauma in older people is associated with mortality that is significantly greater than for similar fractures in the young. Older people are less likely to have care beyond ward level and are often managed in isolation by orthopaedic surgeons. This highlights the need for a review of admission pathways and shared orthogeriatric care in this growing population.

Introduction

The number of older people in the United Kingdom is rising. With a median age of forty years, the elderly are living longer, fertility rates are falling and the population exposed to injury is ageing.[1,2,3] Older people are at greater risk of low-energy trauma secondary to poor physiological reserve, delirium and dementia,[4] lack of urinary control, poor vision and drug interactions.[5] With poorer bone quality than matched younger individuals, the frequency and complexity of fractures in this growing population also increases.[6,7] For any trauma in the elderly, pre-existing systemic disease is more common, increasing complications following injury.[8,9] This overall complexity leads to higher mortality rates,[9,10,11] increased length of hospital stay (LOS), [12] and most importantly, loss of independence and need for enhanced social care[13].

There are models in which the effects of this complexity are lessened. Coordinated care has been shown to reduce time to surgery, LOS and mortality following hip fracture[14,15,16,17] where there is cohorted, multidisciplinary involvement and joint admission under orthopaedic and elderly care consultants. In contrast, should a femoral fracture lie only six centimetres or more below the lesser trochanter, admission under the sole care of an orthopaedic surgeon will occur, a model proven to afford poorer outcomes.

In light of the growing numbers of elderly injured and the complexity inherent with their care, we describe the nature and early management of major trauma in older people with fractures. Perspective is given by the contrasting pathways of hip fracture care. Comparisons are also drawn with younger patients in terms of injury characterisation, severity, outcomes and utilisation of healthcare resources in order to inform debate regarding optimal care for this vulnerable trauma cohort.

Methods

The Trauma Audit and Research Network (TARN) collects data on patients in England and Wales that are admitted to hospital for more than 3 days, require critical care resources, are transferred for further care or who die from their injuries. Certain isolated injuries, such as fractures of the pubic ramus, proximal femur in those aged >65 years, or isolated closed limb fractures are specifically excluded.[2] The TARN database was interrogated to identify a continuous cohort of patients with a pelvic or long bone fracture over the three-year period (2012-2015) since the national inception of the Trauma Network System in England and Wales. Patients were divided into 'younger' (16-64 years of age) and 'older' patients (>64 years of age). Data included age, gender, mechanism and injury distribution (body regions with significant injuries of severity 3 or greater), Injury Severity Score (ISS), comorbidity, Glasgow Coma Score (GCS), procedures (including speciality), critical care stay and mortality. Injury mechanism was categorized into: road traffic collision (RTC), fall from >2m, fall from <2m, shooting/stabbings, blows and other causes. Existing comorbidities were noted and tabulated in terms of the Charleson Co-morbidity Index Score of either 0, 1-5, 6-10 or >10. Statistical analyses were performed through cross-tabulation taking account of frequency distributions in non-categorical variables such as age and injury severity. Pearson's [chi squared] test was employed when there was a requirement for univariate determination of association. The Jonckheere-Terpstra test was applied as there was a priori ordering in the independent variable; i.e. age groups and Kendall's tau was used to determine the effect size. This method allows for handling linear trend across groups in the data and quantifies the strength of the observed effect.

Results

72,942 adult patients sustained pelvic or limb fractures from a total dataset of 142,765 patients between April 2012 and June 2015. Of these 39,525 (54.2%) were aged 16-64 and 33,417 (45.8%) were over 64 years of age. The median age of the younger age group was 47.5 (IQR 31.8-57) compared to 81.9 (IQR 73.6 – 88) in the older group. There were 35,700 male patients (48.9%) with more younger men (64.9%) being injured than elderly (30%) (Table 1). Injury mechanism for the younger group is dominated by RTC and significant falls whilst the older group had a majority of injuries sustained from a fall less than 2m (Table 1).

The overall mortality of the younger patients was 2.5%, compared to 6.8% in the older group and there were marked differences in co-morbidity scores between the two groups. The median GCS of 15 was identical in both groups. Statistical significance for all continuous variables was ($p < 0.0001$) (Table 1). Injury distribution was greater in the younger group and the most common associated injury to have with a fracture is found in the thorax in both the young and the old groups. Other associated injuries included head, spine and abdomen. There was no difference in injury severity between groups. The older group had a median ISS of 9 (8-9) and the younger group was also 9 (9-17) with weak negative effect size of -0.157 ($p = 0.0001$).

Patients that underwent a surgical procedure were allocated into groups by speciality (Table 2). The groups consisted of orthopaedic surgery (OS), plastic surgery (PS), Head Surgery (HS), Spinal Surgery (SS), Thoracic surgery (TS), Abdominal surgery (AS) and interventional radiology (IR). Nearly all (99.8%) of the younger patients underwent an operative procedure with the majority (70.0%) performed by orthopaedic surgeons. In the older group, more patients underwent non-operative management (31.1%). Of those that did have an operation, 82% underwent orthopaedic surgery. There was an increased critical care admission in the younger age group with 18.2% admitted to an enhanced level of care compared to 9.7% in the older population. In order to assess the impact of data quality when using big datasets, analysis was performed for all variables using the high data completeness hospitals that contribute to TARN and also again using all hospitals. There was no difference found in any of the significance levels across any variable for data completeness.

Table 1: Comparison of demographics and mechanism of injury, Comorbidity status and injury distribution, severity and presenting Glasgow Coma Scale

	16-64 years	>64 Years	Total	P value and ; effect size for between group comparison
N	39525	33417	72942	
Median Age (IQR)	47.5 (31.8 - 57)	81.9 (73.6 - 88)	62.1 (45.6 - 80.6)	<0.0001;0.705 ††
N (%)Male (95% CI)	25670 (64.9%) (64.4% - 65.4%)	10030 (30%) (29.5% - 30.5%)	35700 (48.9%) (48.5% - 49.3%)	<0.0001†
Mechanism of Injury: RTC	15964 (40.4%)	3147 (9.4%)	19111 (26.2%)	<0.0001†
Fall > 2m	6076 (15.4%)	2945 (8.8%)	9021 (12.4%)	
Fall < 2m	15177 (38.4%)	26882 (80.4%)	42059 (57.7%)	
Shooting/Stabbing	218 (0.6%)	8 (0%)	226 (0.3%)	
Blow(s)	1012 (2.6%)	178 (0.5%)	1190 (1.6%)	
Other	1078 (2.7%)	257 (0.8%)	1335 (1.8%)	
Co-morbidity Score: Unknown	4204 (10.6%)	2385 (7.1%)	6589 (9%)	<0.0001†
0	28033 (70.9%)	14733 (44.1%)	42766 (58.6%)	
1- 5	5472 (13.8%)	10681 (32%)	16153 (22.1%)	
6 - 10	989 (2.5%)	4100 (12.3%)	5089 (7%)	
>10	827 (2.1%)	1518 (4.5%)	2345 (3.2%)	
Head: n(%) AIS 3+	4425 (11.2%)	2872 (8.6%)	7297 (10%)	<0.0001†
median (IQR)	4 (2 - 5)	4 (1 - 4)	4 (2 - 5)	0.001; -0.031 ††
Spine: n(%) AIS 3+	1818 (4.6%)	1000 (3%)	2818 (3.9%)	<0.0001†
median (IQR)	2 (2 - 2)	2 (2 - 3)	2 (2 - 3)	0.014; 0.028††
Thorax: n(%) AIS 3+	8143 (20.6%)	3252 (9.7%)	11395 (15.6%)	<0.0001†
median (IQR)	3 (3 - 4)	3 (2 - 4)	3 (3 - 4)	<0.0001; -0.143††
Abdomen: n(%) AIS 3+	1559 (3.9%)	279 (0.8%)	1838 (2.5%)	<0.0001†
median (IQR)	2 (2 - 3)	2 (2 - 3)	2 (2 - 3)	<0.0001; -0.068††
Median ISS (IQR)	9 (9 - 17)	9 (8 - 9)	9 (9 - 13)	<0.0001; -0.157††
Median GCS (IQR)	15 (15 - 15)	15 (15 - 15)	15 (15 - 15)	<0.0001; 0.023††

† chi square test †† Jonckheere-Terpstra test & Kendall tau effect size

Table 2: Interventions, critical care episodes and mortality

		16-64	>64	Total	P value
Surgery	Orthopaedic	27809 (70.4%)	18892 (56.5%)	46701 (64%)	<0.0001†
	Plastic	8045 (20.4%)	3300 (9.9%)	11345 (15.6%)	<0.0001†
	Head	937 (2.4%)	206 (0.6%)	1143 (1.6%)	<0.0001†
	Spinal	1228 (3.1%)	267 (0.8%)	1495 (2%)	<0.0001†
	Thoracic	497 (1.3%)	153 (0.5%)	650 (0.9%)	<0.0001†
	Abdominal	889 (2.2%)	199 (0.6%)	1088 (1.5%)	<0.0001†
Interventional Radiology		189 (0.5%)	87 (0.3%)	276 (0.4%)	<0.0001†
Stayed CC		7211 (18.2%)	3225 (9.7%)	10436 (14.3%)	<0.0001†
Mortality with known outcome		930 (2.5%)	2194 (6.8%)	3124 (4.5%)	<0.0001†

† chi square test

Discussion

Eleven million people in the United Kingdom (UK) are aged 65 or older, and this elderly portion of the population grows by 400,000 per year[1]. Across all injury patterns, older people are much more likely to die following trauma than the young.[10,18] In addition to mortality, loss of independence has significant consequences to these patients, their families and the National Health Service. Characterising the profile of older patients with orthopaedic injury through this study, we are able to add to the existing literature with a number of key findings.

We have shown that the nature of care and outcome in patients with fractures differs significantly by age. Older patients with fractures are more likely to die (6.8% v 2.5%) than injury matched younger patients. They are also less likely to have surgery and to receive critical care involvement (9.7% v 18.2%). Where surgery is performed, the majority of procedures in this vulnerable multiply injured group are carried out and then cared for at ward level by orthopaedic surgeons. Mechanism is another key factor. Major trauma (ISS>15) in the UK is dominated by frail patients over 50 years of age that have had a low-energy (<2m) fall [2]. Our data corroborate this as we found a low-energy fall to be causative of injury in older patients in over eighty percent of cases.

Such a fall from standing height is the mechanism for the commonest significant fracture of the elderly, that of the proximal femur. Excluded from this analysis, hip fracture patients benefit from cohorting, shared care and tariff incentivisation. These features, anchored by an orthogeriatric approach, are associated with reducing mortality and length of stay[19,20] improving patient confidence and reducing readmission rates.[21, 22, 23] Non-hip fracture elderly trauma patients such as those in this study currently do not benefit from this model.

Our work introduces new evidence on the impact of age on major trauma patients with fractures in the UK. This new information has associated limitations; it cannot for instance be inferred that mortality is a direct result of causative injury. Simply put, whilst demonstrating that elderly people are falling and have a higher mortality, we cannot state that this is as a direct result of their fall. Regardless of causation, the mortality discrepancy exists and this raises the question as to whether all major trauma elderly patients with fractures be treated along the hip fracture model. Difficult with finite resource and a national shortage of orthopaedic themed elderly care physicians but perhaps a focus for further investigation.

Another potential shortcoming, the information from which these results are calculated and the inference drawn is a prospectively collected national dataset. As such, a potential limitation is the use of ‘Big Data’ evidence synthesis. This accepted, system wide change and care pathway restructuring necessitates data collection beyond the scope of randomised controlled trials or metanalyses[24]. Whilst beneficial in enabling a broad overlook of a clinical problem and its potential impact on service provision, there are limitations inherent with such data. Potentially important sources of variation may remain unknown and unrecorded. Patient experiences and expectations are important variables but are unmeasured in these datasets.

Another potential limitation is specific to the quality of TARN data. The database relies on the precision of trained but non-medical staff inputting data using coding systems.

In order to address this potential limitation, we have assessed the results generated by hospitals with both high and low levels of data completeness and have shown that for the variables investigated, completeness did not affect the results. In addition, this data is collected from both Major Trauma Centres and Trauma Units, increasing the generalisability of the findings. The TARN database excludes isolated closed fractures and so this work is not fully reflective of the overall fracture population, only in those with significant injuries. Whilst this may be perceived as a shortcoming, it does illustrate that the extent of elderly injury is perhaps underrepresented and the disparity and growing size of the issue of elderly fracture care is worse than currently perceived. Causation of injury and the confounding factors of pre-existing morbidity prevent suggestion that older patients are undergoing inferior management than younger patients with similar injuries. This again is a potential limitation of big datasets, although this study aims to highlight more global patterns of outcomes rather to attempt to link causation of injury with mortality.

In conclusion, older patients with significant but low- energy orthopaedic injury have a mortality significantly greater than younger patients. Suggesting reconfiguration of services based on this data alone is a fragile premise. Nevertheless, this study adds to the growing evidence that there are developing two binary trauma populations and their injury mechanism and early clinical needs differ. We suggest that future modelling and research direction should explore new ways of working: early themed senior decision maker input and elderly care physician involvement. Older patients with traumatic injuries may benefit in being managed from the pre-hospital environment in a pathway that is capable of dealing with their complex needs. Already established in hip fracture care, perhaps there should be shared surgical and physician care in place as routine, rather than by request. Outcomes of ‘the frail that fall’ will reflect the next phase of success of trauma care and as a result should be one of the metrics by which institutions are measured and research direction focussed.

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