Toward Improving Prehospital Trauma Triage for Older People

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Portrait photograph

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Abstract

Background: The proportions of older adults with major trauma is increasing. High-quality care for this population requires accurate and effective prehospital trauma triage decisions.

Objectives: Anatomicalal and physiologicalal changes with age, comorbidities, and medications use for older adults may affect the accuracy of prehospital trauma triage.

Materials and methods: This narrative review focuses on age-related anatomicalal and physiologicalal changes, comorbidities, and medications use for older adults with an emphasis on their impact on the accuracy of prehospital trauma triage tools. It also addresses efforts to develop alternative triage criteria to reduce under-triage.

Results: These factors were shown to affect physiological responses to injury and mechanism of injury for older people. Current triage tools poorly predicted injury severity. Geriatric-specific physiologicalal measures and comorbidities significantly improved sensitivity with much lower specificity. Assessing anticoagulant or antiplatelet use in head injury notably improved sensitivity to identify traumatic intracranial haemorrhage, neurosurgery or death with modest decrease in specificity.

Conclusions: Improving paramedics’ knowledge about the challenges when assessing older people with silver trauma may reduce under-triage. Assessing frailty could help in predict injury severity. Future research is needed to improve triage decisions for this population.

Keywords: Triage, Injury, Geriatrics, Paramedics, Emergency.

Introduction

Major trauma has historically been conceived as disease condition of younger populations, resulting from high-energy mechanisms of injury [19]; this thinking is reflected in education and training approaches [5]. However, the proportion of patients with major trauma aged ≥65 years has progressively increased in the last years [7]. In the United Kingdom (UK), the median age of trauma patients increased from 36.1 years in 1990 to 53.8 years in 2013 [19]. Therefore, more age-attuned prehospital triage is needed.

Scope of the Problem

Prehospital trauma triage tools are developed to assess injury severity for patients to determine transportation decisions [38]. They are designed to assess the severity of a single event (i.e. injury), which is not the case when it comes to older people who are at greater risk of silver trauma (define/expand). Older trauma patients are significantly under-triaged in the prehospital phase [3, 6, 9, 22, 26, 27, 28, 33, 39]. This might be due to the process of aging, comorbidities, and medications use in older people which could affect the accuracy of prehospital triage [27]. This paper aims to describe the evidence around these factors and how they might affect the accuracy of prehospital trauma triage for older people in order to improve triage decisions for this population.

Age-Related Anatomical and Physiological Changes

Older adults undergo several anatomical and physiological changes with age. These changes in different body systems could affect their response to injury, which may negatively result in inappropriate assessment of injury severity.

For the cardiovascular system, the heart is subjected to structural changes like hypertrophy and sigmoid septum of the left ventricle [10], and also physiological changes such as reduced diastolic filling of the left ventricle [37] and prolonged contraction period [21]. Blood vessels also undergo structural changes including increased length of large vessels, enlarged lumen, and increased walls thickness [45]. This could impact their compliance and distensibility which is the main functional change of vessels with age [43]. The aorta, for example, has decreased distensibility with age [43]. Such changes were shown to result in lower chance of older adults to present with low blood pressure (hypotension) or increased heart rate (tachycardia), the principal signs of shock [12].

Older adults are at greater risk of impaired respiratory responses with the process of ageing. They have significantly decreased response to hypoxia and hypercarbia [20], decreased pulmonary reserve [13], and decreased ability to effectively clear secretions and fluids from the lungs [13]. Therefore, older adults with chest trauma are at great risk of adverse events including pneumonia, respiratory failure, and death [24].

In regard to the nervous system, brain atrophy was shown to increase with age and accelerate after the age of 60 years [15]; allowing more space between brain and skull which could accumulate a high volume of blood without presenting any sign of increased intracranial pressure [36]. This, as a result, could delay the diagnosis of intracranial bleeding among older people [36]. The structure and function of the blood vessels are also impaired with aging including arterial stiffness and endothelial cells dysfunction [46]. These cerebrovascular changes could increase the vulnerability of intracranial hemorrhage for this population post injury.

Ageing is associated with progressive loss of skeletal muscle mass and strength (sarcopenia) which could negatively impact mobility and balance [16]; increasing the risk of severe injury from falls [40]. Osteoporosis increases the risk of fractures [17], from even low energy mechanisms (i.e. low-level falls) in older people [11].

Comorbidities

Comorbidities can significantly change the physiological responses to trauma for older people. High blood pressure (hypertension) is a common comorbidity for older people and is a significant risk factor of cardiovascular and cerebrovascular diseases [23]. Its presence could impair the response to shock post injury for this population. Older adults are great risk of developing Chronic Obstructive Pulmonary Disease [8] which could adversely affect the response to hypoxia and hypercarbia post injury. Chronic Kidney Disease is also another common comorbidity among older people and could lead to decreased renal function and increased risk of Adverse Drug Reactions (ADRs) [25].

Medication use

The use of medications is more common in older people than younger populations, particularly, for those with comorbidities. Older people are more common to use anticoagulants which could significantly increase their risk of intracranial hemorrhage following head trauma [2]. As hypertension is also common in this population, they are also more likely to take antihypertensive drugs to control their blood pressure. Antihypertensive drugs were shown to increase the risk of serious fall injuries in older people [41]. Such important medications and others that are commonly used in this population could impact their response to injury and lead to inappropriate assessment of injury severity.

Apart from the medications themselves, the term ‘polypharmacy’, which is defined as using multiple medications and/or administering additional medications that are not clinically indicated which represents unnecessary medications use, is common among older people [14]. This issue continues to increase in this population and is a wellknown risk factor of their death and disability [14]. Polypharmacy is significantly associated with the incidence of ADRs in older people; adding a greater risk of poor outcomes [1]. Other issues in this population with medications use include disparity between the labeled dosage and the actual used dosage, drug interactions, and underuse of medications [31]. All of these issues should be considered during the assessment and management of injured older patients.

The impact on the accuracy of prehospital triage

These which factors? were shown to have an impact on the accuracy prehospital trauma triage including physiological responses and mechanism of injury. The findings of physiological responses of older people in prehospital trauma triage are summarised in Table 1. A recent study found that even when injured older patients met the physiological criteria, they had low chance of being transported to a Trauma Centre (TC); 24% of hypotensive patients (SBP<90mmHg), 23% of those with abnormal RR (<10 or >29) , and 26% of those with a GCS <13 were transported to a TC [26].

Table 1 Physiological responses of older people post injury.

Physiological Variables	Findings from Prehospital Trauma Triage Studies
Systolic Blood Pressure (SBP)	• Patients aged >55 years were less likely to present with shock compared to younger adults (SBP <90 mm Hg) [SBP, mm Hg, mean (±SD):144 (33) vs. 131 (29)] [9]. • Patients aged >55 years with major trauma were less likely to have SBP <90 mm Hg than younger adults [n (%): 234/3054 (7.7) vs. 565/4407 (12.8), p =0.001] [6]. • There are decreasing rates of trauma patients presenting with hypotension (SBP <90 mm Hg) with age [22].

Heart Rate	• Patients aged >55 likely to have tachycardia than younger adults [Heart Rate (HR), beat per minute, mean (±SD): 82.7 (20) vs. 91.7 (25)] [9]. • Patients aged >55 years with major trauma were less likely to have HR >124 than younger adults [n (%): 163/3054 (5.3) vs. 609/4407 (13.8), p =0.001] [6]. • There are decreasing rates of trauma patients presenting with tachycardia (HR >100) with age [22].
Respiratory Rate (RR)	• Patients aged >55 years with major trauma were less likely to have abnormal RR (RR <12 or >24) than younger adults [n (%): 395/3054 (12.9) vs. 904/4407 (20.5), p =0.001] [6].
Glasgow Coma Scale (GCS)	• Older trauma patients aged >55 years, compared to their younger counterparts, had higher GCS [mean (±SD): 14.2 (2.4) vs. 13.6 (3.5)] [9]. • Patients aged >55 years with major trauma were less likely to have GCS <13 (RR <12 or >24) than younger adults [n (%): 574/3054 (18.8) vs. 1125/4407 (25.5), p =0.001] [6]. • These findings are consistent with the findings of other studies which showed higher GCS among patients aged ≥65 years with trauma brain injury compared to younger adults [18, 34]

These factors were also found to affect the mechanism of injury (i.e. increase the risk of low-level falls) which is now the most common mechanism of injury in the UK (falls <2 meters) [42]. The assessment of triage patterns for injured adults showed increasing rates of patients who had falls with age (from 12% of patients aged 16-25 years to 77% of patients aged >65 years, p <0.05) and decreasing rates of motor vehicle accidents (from 52% of patients aged 16-25 years to 16% of patients aged >65 years, p <0.05) [22]. Indeed, most injuries among patients aged ≥65 years occurred at home usually due to falls from standing height (62%) [3]. An earlier study showed that trauma triage tool failed to identify major trauma resulting from falls (94% under-triage) [33]. Falls were related to 70% of the hospitalisations of these patients and 45% of those with major trauma had falls [33]. Most injured patients aged ≥55 years due to falls were transported to non-TC (63.4% vs. 33.9%, p < 0.001) [39].

Adjusting prehospital trauma triage

Recent literature has investigated modifying and developing specific trauma triage criteria for older people. The application of the criterion (SBP <110 mm Hg) instead of (SBP <90 mm Hg) in the prehospital trauma triage tool was assessed for older adults [4]. It was shown to reduce the rate of under-triage by 4% and increase the rate of over-triage by 4% [4]. As the risk of death for older trauma patients who had a SBP<110 mm Hg is similar to those with a SBP <90 mm Hg, this may highlight the importance of applying this criterion for direct transport of these patients to TCs [4].Is this clinically important?

A recent study developed specific criteria for prehospital trauma triage of older adults aged ≥55 years [28]. It showed that HR was not associated with major trauma (Injury Severity Score [ISS] >15) in adjusted models (p = 0.48) and was excluded from further analysis [28]. In the revised triage tool, the study showed that GCS ≤14 was the most predictive variable of ISS >15 [28]. Replacing current criterion (GCS ≤13) with GCS ≤14 in the trauma triage tool could decrease the rate of under-triage (sensitivity from 78.6% to 84.1%) with similar increase in the rate of over-triage (specificity from 75.5% to 68.4%) [28]. Adding RR <10 or >24 (including the need for assisted ventilation) was the second most predictive physiological measure as it improved sensitivity from 78.6% to 84.5% but had more lower specificity from 75.5% to 66.9% [28]. However, the change of under-triage for respiratory status compared to GCS was small (sensitivity, 84.5% and 84.1%, respectively); indicating that many patients with abnormal RR were already identified with abnormal GCS [28]. Shock index >1.0 and SBP <110 or >200 mm Hg improved sensitivity by similar change (from 78.6% to 86.4% and 86.3%, respectively) with also similar much lower decrease in the specificity (from 75.5% to 60.4% and 60.7%, respectively); resulting in lower predictive value than GCS and RR [28].

Adding the count of comorbidities was assessed in a developed triage tool for injured older adults aged ≥65 years [27]. Recursive partitioning identified predictors in order; any current criterion in the triage tool, GCS ≤14, abnormal geriatric specific physiological criteria (RR <10 or >24, SBP <110 or >200 mmHg, and HR ≤60 or ≥110 beat per minute), and comorbidity count ≥2 [27]. This triage tool had 90.3% sensitivity (95% Confidence Interval [CI], 86.8%–93.7%) and 17.0% specificity (95% CI, 15.8%–18.1%) to identify patients with ISS >15 or require major non-orthopaedic surgery compared to current triage tool which had sensitivity of 36.6% (95% CI, 31.2–42.0%) and specificity, 90.1% (95% CI, 89.2%–91.0%) [27]. It was also found to have sensitivity and specificity to predict short and long-term mortality similar to other definitions of high-risk patients compared to current triage tool which was poor [27]. Anticoagulant use was assessed in this study and found not to be a primary predictor in recursive partitioning analyses. Adding this criterion to the developed triage tool showed 94.1% sensitivity (95% CI, 90.1%–98.1%) and 14.0% specificity (95% CI, 12.6%–15.4%). When comorbidity count was replaced by medication use, the triage tool showed 78.9% sensitivity (95% 71.5%–86.2%) and 40.8% specificity (95% CI, 38.7%–42.9). This showed that geriatric-specific physiology measure and comorbidity count are primary predictors of major trauma for this population.

Anticoagulant or antiplatelet use was assessed to be added to current prehospital trauma triage tool when assessing patients aged ≥55 years with head injury [29]. The study showed that applying physiological, anatomical, and mechanism of injury criteria in the triage tool had poor sensitivity in identifying traumatic intracranial haemorrhage (26/131; 19.8%, 95% CI 5.5-51.2%) and in-hospital death or neurosurgery (14/41; 34.1%, 95% CI 21.6-49.5%) [29]. Adding the criterion of anticoagulant or antiplatelet use in the triage tool had improved its sensitivity to identify traumatic Intracranial Haemorrhage (tICH) (78/131; 59.5%, 95% CI 51.0-67.6%) and death or neurosurgery (29/41; 70.7%, 95% CI 55.5-82.4%) with modest decrease in specificity from (1843/1979; 93.1%, 95% CI 91.2-94.7%) to (1329/1979; 67.2%, 95% CI 61.1-72.7%) [29].

Recommendations for Practice and Future Research

Older adults were shown to have unique factors that could impact their response to injury and reduce their chance to meet current triage criteria. Therefore, paramedics should focus on improving their knowledge about the changes in anatomy and physiology with age, the impact of comorbidities and medications use on response to injury and assessing injury severity for this population. This will aid paramedics to improve their judgments and triage decisions. A recent systematic review showed that paramedic judgment could decrease the rate of under-triage for trauma patients especially for those who did not meet the triage criteria [44]. The assessment of 'frailty' could also help in determining the severity of injury for these patients. It was shown to be an independent predictor of adverse outcomes for older trauma patients [32, 35]. Applying simple frailty assessment tools like the Clinical Frailty Scale (CFS), which was determined to be feasible, reliable, and accurate to apply in emergency care [30], could be used in prehospital phase. The CFS was shown recently to independently predict 30-day mortality, inpatient delirium, and increased care level at discharge in older people aged ≥ 65 years post injury [35].

Apart from this, further research is needed to improve prehospital triage decisions for injured older patients to assess and look into:1) the accuracy of different triage tools as most studies were published in the United States of America and Australia, 2) the development of application of more accurate geriatric-specific trauma triage criteria as most developed criteria were more highly sensitive but lack acceptable specificity, and 3) the destination compliance for positively triaged patients as older patients who met the triage criteria seemed less likely to be transported to a TC.

Conclusion

Older adults have unique factors related to the anatomical and physiological changes with age, comorbidities, and medications use which were shown to affect their physiological responses to injury and mechanism of injury. Current triage criteria had poor sensitivity to capture older people with major trauma. Geriatric-specific physiology measures and comorbidity count significantly improved sensitivity of prehospital triage with much lower specificity. Adding the criterion of anticoagulant or antiplatelet use for those with head injury could significantly improve the sensitivity for predicting tICH and death or neurosurgery with modest decrease in specificity. Paramedics' knowledge about the challenges when assessing and managing these patients could improve their judgments. Assessing frailty using, for example, the CFS could aid in assessing injury severity. More research is needed to improve early and appropriate identification and triage decisions for this population.

Strengths and weaknesses of this paper

Implications for research

Implications for clinical practice

Compliance with Ethics Guidelines

Conflict of interest: The authors declare that they have no competing interests.

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