Current Trauma Reports (2020) 6:125–132
https://doi.org/10.1007/s40719-020-00206-6

GERIATRIC TRAUMA (B JOSEPH, SECTION EDITOR)

Geriatric Trauma: Triage Guidelines

Zachary Warriner[1] · Andrew C. Bernard[1]

Accepted: 23 October 2020 / Published online: 31 October 2020

Abstract

Purpose of Review This review focuses on triage decisions and early decision-making in the management of the acutely injured elderly patient.

Recent Findings The geriatric population in the USA is experiencing the largest growth in history, and injury has become an increasingly common cause of death in those aged 65 years and older. Morbidity and mortality are markedly increased compared to younger patients so trauma providers must critically evaluate triage, diagnostic, and early management decisions. Numerical age has also been called into question as the ideal barometer of enhanced risk for poor outcomes, as physiologic status and markers of frailty have been suggested as more specific. But traditional physiologic markers of severe injury may not be reliably present in the injured elderly, risking potential undertriage of severely injured patients.

Summary Triage of the geriatric trauma patient can rapidly guide trauma system or trauma team interventions to reduce morbidity and mortality in this high-risk patient population.

Keywords Guidelines · Elderly · Injury

Introduction

Trauma is the third leading cause of death across all age groups in the USA according to the Centers for Disease Control. While unintentional injury disproportionately affects the young, from ages 45–64, it is surpassed only by cancer and heart disease. Beyond age 65, injury remains a major contributor to overall mortality, with nearly 60,000 deaths reported in 2018 alone, recently surpassing deaths related to influenza and pneumonia combined [1]. As the population older than 65 is the most rapidly growing demographic nationally, the overall burden of injury will only increase in the coming years, making this potentially preventable cause of death even more relevant [2].

Older patients also experience higher rates of mortality from comparatively minor injuries. Though this fact is generally accepted, the age at which increased risk begins is debated in the literature and there is no standard age criterion that identifies the geriatric trauma patient [3–6]. Relatively high mortality risk among older patients presents an important opportunity for earlier intervention that may help mitigate risk [7, 8]. Proper triage has been shown to positively affect outcomes in the injured elderly so accurate triage should begin at the point of injury and be repeated through the phases of care [9–11, 12••, 13].

Optimal triage of the elderly trauma victim is an area of active investigation. Evidence both supports [8, 9] and refutes [14] the value of triage based on numerical age alone. Frailty and comorbid conditions may represent more specific indicators of increased mortality risk after injury, but these are more difficult to measure quickly during initial evaluation, resuscitation, and transport. The optimal triage tool for geriatric trauma will be simple and rapid, will correctly identify patients for whom trauma center care will be beneficial, and will have a low rate of overtriage.

Historical Perspective

In 1986, the American College of Surgeons Committee on Trauma (ACSCOT) published its first guidelines for field triage of the injured patient [15]. Now revised and updated, the

This article is part of the Topical Collection on *Geriatric Trauma*

✉ Zachary Warriner
zacharydwarriner@uky.edu

Andrew C. Bernard
andrew.bernard@uky.edu

[1] Division of Trauma and Acute Care Surgery, Chandler Medical Center, University of Kentucky, 800 Rose St, Lexington, KY 40536, USA

Field Triage Decision Scheme rapidly assesses physiology, catalogs anatomic injury, and estimates of injury severity by mechanism and in so doing assists in prehospital decision-making, identifying patients who will benefit from the resources provided by a designated trauma center.

Age has long been considered a risk factor for surgical morbidity and mortality. The first major outcomes analysis to specifically identify this age-related discrepancy in trauma across a large population was the 1990 Major Trauma Outcome Study which highlighted increasing mortality associated with advancing age following injury, occurring across all mechanisms of injury, injury severities, and body regions [3].

In their revised National Trauma Triage Protocol Guidelines in 2009, the ACSCOT and the CDC have recommended special consideration be given to all trauma victims older than age 55, recommending direct trauma center transport for low-impact mechanism of injury and those who are anticoagulated [15]. It is also recommended that in patients older than 65, the threshold for hypotension be raised to a systolic blood pressure of 110 mmHg [15].

Increased mortality due to age has been attributed to several mechanisms, including declining cellular function, increasing frequency of preexisting medical problems [16, 17], declining functional reserve, and an impaired physiologic response to the stress and metabolic demand of injury [18, 19]. Though many changes of aging are gradual and vary by individual, attenuation of the metabolic response to injury appears to be most predictable, consistently occurring around age 60 [20], an age that correlates well with the sharp increase in mortality originally shown in the Major Trauma Outcome Study [3]. Multiple subsequent analyses have affirmed the exaggerated effect of trauma on older patients, underlying a lower threshold to triage elderly patients to trauma centers and trauma teams [13, 16, 17, 20–23].

Unfortunately, questions around geriatric triage remain. Many prospective clinical studies in trauma exclude geriatric patients, leaving a dearth of high-quality data. Some studies have purposely excluded older patients due to their worse outcomes or excluded them on subgroup analysis due to missing variables or early mortality. These and other reasons have been suggested for failure of large database studies to adequately represent geriatric patients [24••]. Despite these limitations, some principles of geriatric triage are supported by recent studies and the authors will review these below in order to confidently inform trauma system and trauma center design.

Defining "Elderly"

While a substantial body of literature has proven increased morbidity and mortality following injury in the elderly trauma population, the definition of "elderly" is not uniform. Even within the trauma literature, the age at which outcomes worsen ranges from 55 to 80 years (Table 1). Although most providers use age 65 to define elderly, including the authors, some studies even show an increase in trauma mortality beyond age 45 [13, 16, 21, 25•].

Increasing age strongly correlates with mortality following geriatric trauma, with a 6.8% increased risk of death for every year beyond age 65 [22]. But in most cases, age serves simply as a surrogate for comorbid conditions, medication use, and decreasing physiologic reserve. Older trauma victims are more likely to present with preexisting conditions, with an increasing risk of mortality as the number of associated conditions increases, even after controlling for age and injury severity [17]. Hepatic disease, cardiac dysfunction, chronic kidney disease, and cancer showed the strongest correlation with trauma mortality [17, 22]. Even in the apparently "stable" patient, a history of congestive heart failure or cerebrovascular accident is associated with a substantial increase in mortality [26]. Dissecting the relative impact of age vs. age-related medical problems on trauma outcome is a major focus of investigation [17, 22, 27•].

Frailty represents one such clinical syndrome that may not be present in all older patients but has been clearly shown to predict worse outcomes after injury. Frailty, measured in numerous ways, correlates with mortality, hospital length of stay, quality of life, and discharge disposition, often more reliably than age alone [28–30]. Unfortunately, no frailty scale or scoring system is proven superior, and most tools are used in the inpatient setting to predict discharge disposition rather than being used prehospital for purposes of trauma triage. Some scales involve a series of interview questions or physical assessments that are impractical, at least initially. Many frailty assessments may be difficult or impossible to implement in the emergent setting [27•, 30].

For triage purposes, more simple and rapid methods are necessary to identify patients who need aggressive care or those at highest risk of a poor outcome. Surrogate markers of frailty, such as basic functional status and sarcopenia, have been suggested in the triage setting [27•]. One method tested in the field is a simple upper-extremity function test, requiring only 20 s to complete, predicting discharge disposition and death, readmission, and even risks of subsequent falls [31]. Innovative field assessments such as this could potentially be combined with age and preexisting conditions to produce novel triage tools that are superior to any single current method.

Triage Criteria

Triage involves prioritizing and matching the injured patient with the appropriate medical resources available. This should begin immediately after injury, even prior to the initial evaluation of the patient, using any available information to the care

Table 1 Age criteria for triage

Age	Outcome	Reference
45	Increased inhospital complications, mortality	Adams
55	Increased mortality	Sasser
60	Attenuated metabolic response	Frankenfield
60	Increased mortality	Champion
65	SBP 110 mmHg = 90 mmHg	Brown
65	HR 90 = HR 130	Heffernan
65	Occult hypoperfusion despite "normal" vital signs	Martin
65	6.8% increased mortality yearly	Grossman
65	4× mortality and disability if undertriaged	Lehmann
65	Current field triage criteria sensitivity only 36.6% for patients with ISS > 16	Newgard
65	Shock index superior to BP or HR	Pandit
70	Improved mortality when used as a blanket criterion for trauma team activation	Demetriades, Hammer

SBP systolic blood pressure, *ISS* injury severity score, *BP* blood pressure, *HR* heart rate

provider, such as scene report, caller information, and vehicle engineering. Triage can be used in the field to determine prehospital response, the optimal destination of transport, whether and at what level the trauma team is activated, and even how the trauma team responds and works once the patient arrives. Classically, field triage was based on physiologic criteria (vital signs, Glasgow Coma Scale), anatomic injury, and mechanism of injury. Now, we add provider judgment, preexisting illness, geography, time to transfer, and trauma center verification level to determine the optimal destination.

Triage is also the basis for hospital trauma team activation. This internal triage process has been and continues to be shaped by the ACSCOT's *Resources for the Optimal Care of the Injured Patient* [32], balancing resource utilization with injury severity or need for immediate intervention. While age is not one of the mandatory criteria for trauma team activation for ACS-verified trauma centers, the increased risk of death following injury for older patients is highlighted in the National Trauma Triage Protocol guidelines, as well as the ACS TQIP Geriatric Management Guidelines, and should be considered when creating hospital trauma protocols [15]. Age-specific amendments to the traditional triage criteria have been recommended and successfully implemented in many centers, including the addition of age as a mandatory activation criterion. Using age > 70 as an internal activation criterion, two different centers report lower mortality [7, 33•]. As the ACS directs, trauma centers must use continuous assessment of overall effectiveness of their age criteria to balance over and under triage in the elderly.

Standard triage criteria that indicate severe injury in younger patients may not be sufficient or accurate in the elderly. While typically reliable in younger patients, heart rate and blood pressure often lack sensitivity to predict hospital mortality or need for urgent intervention in those > 65 years of age [4]. Lack of sensitivity of standard hemodynamic parameters partly explains why elderly patients have four times the mortality and discharge disability of younger similarly injured patients if undertriaged [4]. One recent cohort study using current field triage practices demonstrated a sensitivity of only 36.6% to identify severe injury (ISS > 16) or need for major non-orthopedic surgery in patients older than age 65 [34••]. This loss of sensitivity can be related to inadequate vital sign response, comorbid conditions that prevent inadequate stress response, and medications that inhibit the normal pathways that maintain and augment cardiac output after injury. This "relative hypotension" represents a lack of an appropriate response to injury, or hypotension relative to the patient's baseline prior to injury, and may only be recognized with other evidence of tissue hypoperfusion or shock despite a seemingly "normal" blood pressure [35]. Increasing the traditionally considered threshold for systolic hypotension from 90 to 110 mmHg has been recommended by the National Trauma Triage Protocol guidelines to account for this risk, supported by comparable mortality at both values in patients > 65 years of age [36], and similar mortality at this threshold to younger patients who present with a systolic blood pressure of 95 mmHg [23]. This has prompted many centers to amend their preexisting blood pressure targets in elderly trauma victims.

Shock index, the ratio of heart rate to SBP, has also been studied as a predictor of mortality in the elderly. Although hypotension in geriatric patients may begin at 110 mmHg and tachycardiac response may be blunted related to polypharmacy, elevated shock index predicts mortality. Shock index may be superior to either heart rate or systolic blood pressure in predicting mortality in patients greater than 65 years of age [37]. This parameter carries the significant benefits of being immediately available and repeatable.

In addition to objectively measurable triage criteria, "provider discretion" has sometimes been considered an acceptable criterion for trauma center evaluation and trauma team

activation. For example, in one study, EMS provider judgment proved superior to objective field triage criteria alone in identifying patients with traumatic intracranial hemorrhage [38]. Field judgment has been proven to save lives, and an experienced provider's suspicion of need for trauma center evaluation should be respected [13].

Some trauma systems have amended triage guidelines to capture elderly patients. Trauma system participants in Ohio created an "evidenced-based geriatric-specific field-destination criteria" from a statewide registry, identifying GCS < 14 with suspected or known TBI, SBP < 100 mmHg, fall from any height with evidence of traumatic brain injury, multiple body-system injuries, being struck by a moving vehicle, and presence of any long bone fracture following motor vehicle trauma as correlating with increased mortality in patients aged 70 and older [39]. These parameters were then added to existing field triage criteria, and subsequent analysis demonstrated an improved sensitivity in identification of both need for trauma center care and ISS > 15 when compared to standard guidelines [40]. In a follow-up study to assess adherence to this protocol and its effect on timeliness of interfacility transfer, lack of trauma center availability was found to be the major barrier to appropriate triage in the elderly so further trauma system development was needed [41].

Sometimes elderly trauma victims arrive in hospitals not suited to meet their needs. Following initial hospital evaluation, interfacility transfer should be considered if patient needs surpass the level of care available at the initial receiving hospital. Interfacility triage may occur after initial stabilization, upon identification of unexpected injuries, or when a specialist is needed but not available. In every case, transfer should be initiated as soon as the need is recognized. In the elderly population, consideration of geriatrician specialist availability, including multidisciplinary teams experienced in management of geriatric trauma victims, is of critical importance. Especially in elderly patients, if needs appear to exceed local resources, rapid transfer is strongly encouraged [10, 11, 12••, 13].

Over- vs. Undertriage

The concept of "mistriage" describes misaligning resources with clinical need of the patient, either as over- or undertriage. "Overtriage" describes overuse or unnecessary trauma center or trauma team care, while "undertriage" represents inadequate resource deployment or failure to recognize trauma center need in patients that ultimately require specialist, operative, or ICU care.

Because of the potential for poor outcome in undertriage, the ACSCOT recommends an undertriage rate of 5% or less, erring on the side of sensitivity rather than specificity for severe or immediately life-threatening injury [32]. Absence of well-defined triage criteria or inappropriate use of the triage tool by the triaging provider leads to undertriage and morbidity and mortality. Some patients are not captured even by highly sensitive tools that are properly applied. As inadequate resource utilization or deployment represents a preventable problem with risk of harm, most trauma triage research and prehospital education has focused on reducing undertriage.

Patients also may appear more seriously injured than they are. Triage criteria may be too liberal, capturing those who are not actually at risk of severe injury or poor outcome. While this does not pose a direct risk to the individual patient, unnecessary use of limited resources increases healthcare costs and absorbs trauma center and system resources. Waste has the potential to adversely affect current and future patients [2]. Overtriage threshold has been suggested to be 25–35% [32].

To maintain optimal balance of over- and undertriage, "rigorous multicenter performance improvement" is recommended [32]. Age is the most studied triage criterion with respect to over/undertriage [9] (Table 2). In one study in Los Angeles, improved survival and reduced permanent disability were realized after implementation of age > 70 as criterion for trauma team activation. This benefit was attributed to early intensive monitoring, evaluation, and resuscitation when compared to those patients who did not meet trauma team activation criteria [7].

Undertriage has been shown to occur more frequently in the elderly, and delayed intervention correlates with disposition to rehabilitation and longer hospital length of stay [44]. Multiple factors underlie undertriage and it even occurs in relatively low severity mechanism injuries [42]. Patients with significant injury severity may present without hypotension or tachycardia. In one study, mortality in geriatric patients with "normal" vital signs was 16% [12••]. While mortality significantly increased in elderly patients who meet standard activation criteria compared to those who met age criteria alone, a significant portion of those who only met age criteria had ISS > 15 (27.5%), ISS > 25 (11.6%), or required ICU admission (56.6%). Importantly, 12% of these patients required immediate intervention by the trauma team, identified by immediate activation [45]. This study highlights both the potential prevalence and the importance of undertriage. Age 70 has been adopted by numerous centers as a criterion for trauma team activation with lower mortality, length of emergency department stay, and discharge disposition [32, 46, 47]. Other studies have suggested even higher age limits could achieve the same benefit with no increase in undertriage [48].

Unfortunately, simply increasing the rate of trauma team activation or early involvement in geriatric trauma patients does not guarantee improved survival or altered outcomes across all reported analyses [46, 49, 50]. For example, one study showed that in traumatic brain injury, early intervention failed to demonstrate a survival benefit [46]. Further study and continual monitoring of quality measures at each trauma center and within each system are needed to avoid unnecessary resource utilization that occurs with overtriage as a result of broader activation criteria suggested by many [7, 33•].

Table 2 Geriatric trauma triage criteria

Criterion	Outcome	Reference
Age (> 45, > 55, > 60, > 65, > 70)	See Table 1	See Table 1
SBP < 110 mmHg	Increasing mortality, comparable to those who present with SBP < 90 mmHg	[23, 36]
HR > 90	Increasing mortality, comparable to younger patients who present with HR > 130	[23]
Multiple comorbid conditions	Increasing mortality with increasing preexisting conditions	[16, 17, 25•, 26]
Evidence of decreased physiologic reserve or frailty	Increased mortality despite low mechanism of injury, increased mortality, and unfavorable discharge disposition	[28, 42]
Provider discretion	Decreased undertriage, improved mortality when appropriately triaged to trauma center	[13, 38]
Suspicion of TBI	Improved triage sensitivity in identifying patients with ISS > 15, or within 48 h, ICU stay, and mortality	[38–40]
Significant chest, abdomen, pelvic, or extremity trauma	Improved triage sensitivity in identifying patients with ISS > 15, or within 48 h, ICU stay, and mortality	[39, 40]
GCS < 14	Improved triage sensitivity in identifying patients with ISS > 15, or within 48 h, ICU stay, and mortality	[39, 40]
Auto vs. pedestrian	Improved triage sensitivity in identifying patients with ISS > 15, or within 48 h, ICU stay, and mortality	[39, 40]
Any long bone fracture following MVC	Improved triage sensitivity in identifying patients with ISS > 15, OR within 48 h, ICU stay, and mortality	[39, 40]
SI > 1	Increased mortality, inhospital complications, need for blood transfusion, laparotomy	[37]
Multiple body systems injured	Improved triage sensitivity in identifying patients with ISS > 15, or within 48 h, ICU stay, and mortality	[39, 40]
Known anticoagulant use, any age	Reduced time to urgent intervention, anticoagulation reversal, and mortality	[15, 34••, 43••]

SBP systolic blood pressure, *HR* heart rate, *TBI* traumatic brain injury, *GCS* Glasgow Coma Scale score, *MVC* motor vehicle collision, *ISS* injury severity score

Special Considerations

Falls in the Elderly

Falls are now the most common mechanism of injury and the leading cause of trauma-related death in the elderly [1, 2]. While falls are considered a low-energy mechanism, the physiologic impact on the patient may be substantial due to the relatively poor injury tolerance in geriatric trauma patients [42]. The prevalence of these cases combined with the fact that many of these patients already have serious underlying medical problems can create a certain nihilism with respect to the diagnostic evaluation. This nihilism may manifest as dismissal or incomplete evaluation. Since earlier intervention improves outcomes, consideration of the risk of undertriage is paramount [2]. A lower threshold for high level trauma team activation has shown value in falls, as has a lower threshold for advanced imaging [51•]. Additionally, directed triage to centers that can provide rapid intervention and fixation of orthopedic injuries is recommended, as delayed time to repair correlates with increased mortality [52]. In our opinion, fractured patients should go to centers with fracture surgeons. In addition to our recommendation for comprehensive geriatric assessment for injury regardless of mechanism, we strongly support evaluation of contributing factors, including cardiac, neurologic, or other identifiable cause [53]. If these resources are not available, then transfer to an appropriate center is recommended.

Anticoagulation and Antiplatelet Use

Due to the potential for rapid deterioration in the anticoagulated patient with head injury, the National Trauma Triage Protocol Guidelines were revised to encourage preferential transport or referral of anticoagulated patients to trauma centers capable of immediate evaluation and intervention [15]. The ability to quickly reverse anticoagulation or antiplatelet medication is important, as delayed time to reversal may increase mortality. Even in the mild TBI, trauma center transfer has been correlated with improved survival, supporting this practice in all levels of injury severity [43••]. Including anticoagulant use as criterion for activation has been shown to reduce rates of undertriage, as well as expedite timely mobilization of important clinical resources [54]. Adding pre-injury anticoagulant use to trauma activation protocols reduces mortality [55]. In our center, anticoagulant use is a tier 2 activation criterion, regardless of mechanism of injury.

Palliative Care

Palliative care is the provision of high-quality care that is consistent with patient and family goals, giving attention to physical symptoms including pain. Early discussion of goals of care with patients and families is recommended by the ACSCOT Geriatric Trauma Guideline. Palliative care can begin at the time of triage. If the patient or their healthcare-appointed surrogate is able to clarify desired treatments or care wishes early, unnecessary resource utilization, implementation of invasive care, or long-

distance transfer away from family or other support systems may be avoided, benefiting patients and providers alike. Failure to appreciate or respect advanced directives, living wills, or discussions with a healthcare power of attorney can complicate care and adversely affect outcomes [56]. If likelihood of survival or a desired functional outcome is very low, interventions and triage decisions may be tailored. Communication is critically important to establish and modify care goals to be aligned with the patient and family wishes [57]. This is of particular importance in patients who present from long-term care facilities. Long-term care patients with severely acute illness or injury are at considerable risk for inhospital and 30-day mortality [58].

Conclusions

Geriatric trauma patients comprise a high-risk population in whom triage can identify those in need of specialized assessment and intervention and reduce morbidity and mortality. Age, physiologic criteria, mechanism of injury, and medical comorbidity can collectively be used to develop triage tools for trauma systems and trauma centers. Each triage criterion has an inherent rate of over- and undertriage. Novel triage methods like frailty assessment and novel technology promise to reduce over- and undertriage. Victims of fall, patients taking anticoagulants, and patients in whom there may be limits on care due to pre-expressed wishes are uniquely vulnerable and warrant early, careful assessment and consideration for trauma center transfer. Continued study and refinement of geriatric trauma triage tools is necessary to maximize patient benefit and appropriately use healthcare resources.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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