

# Geriatric Trauma

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## INTRODUCTION

The incidence of trauma in the elderly is increasing. Older patients are less able to tolerate injury due to physiologic alterations associated with aging. Clinicians need to approach geriatric trauma with a high degree of suspicion to promptly recognize and treat injuries and rescue patients from their initial injury and its potential complications.

## EPIDEMIOLOGY

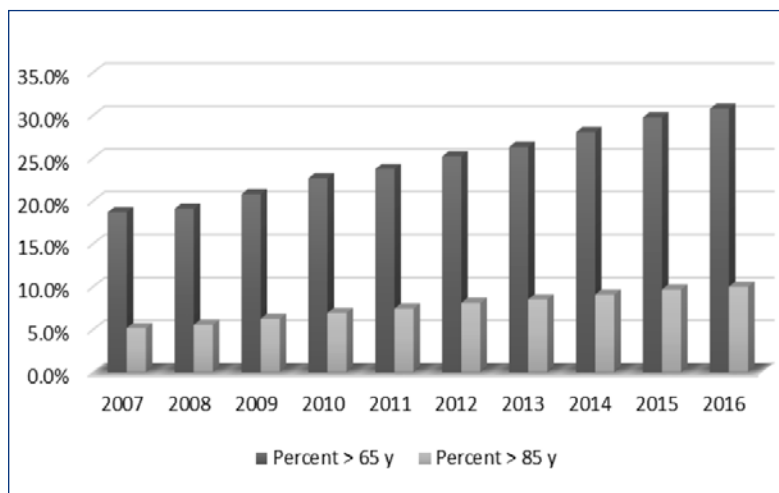
Trauma is considered a young person's disease, but the aging of the population is changing that reality. People over 65 are the fastest growing demographic, and by 2020 they will comprise over 20% of the US population.<sup>1</sup> People are living longer, and many of them lead active lifestyles which increase their exposure to trauma. Conversely, a greater proportion of elderly people are living with comorbidities, and this increases their vulnerability to injury. The net effect is an increase in elderly trauma patients, and this is reflected in the proportion of patients over 65 admitted to trauma centers. (Figure 1) At the Rhode Island Trauma Center (RITC) at Rhode Island Hospital, the mean age of admitted trauma patients has increased from 50.9 to 61.3 years

over the past decade. The cost of trauma care is rising faster than overall healthcare spending, and much of this is driven by the expansion of geriatric trauma in terms of numbers, complexity and resource use.<sup>2</sup>

## TRIAGE & TRAUMA CENTERS

The Eastern Association for the Surgery of Trauma (EAST) guidelines recommend that patients over 65 years of age with comorbidities or severe anatomic injury should be treated at trauma centers. Centers that treat a higher volume of geriatric patients have improved outcomes with regard to mortality, complications, and failure to rescue (FTR), defined as death after a complication.<sup>3</sup> However, fewer than 50% of patients are appropriately transferred to a higher level of care, and the risk of under-triage increases with age, fall mechanisms, and female gender.<sup>4</sup> This under-triage reflects a failure to appreciate the severity of even minor injury in elderly patients, and contributes to the fact that elderly trauma patients have worse outcomes than younger patients with the same degree of injury. Because early activation of trauma teams and aggressive monitoring improve outcomes in elderly patients, clinicians should have a low threshold to transfer older patients to a trauma center. There are very few "minor" injuries in geriatric patients.

Figure 1. Geriatric admissions to trauma centers 2007–2016



The percentage of geriatric patients as a fraction of all trauma admissions has increased from 18.7% in 2007 to 30.8% in 2016. Data derived from National Trauma Data Bank (NTDB) annual reports. Committee on Trauma, American College of Surgeons. Chicago, IL. <https://www.facs.org/quality-programs/trauma/tqpc/center-programs/ntdb/docpub>

## ALTERED PHYSIOLOGY

The numerous physiologic changes associated with aging along with co-morbidities complicate the recognition of injury severity, compromise the body's response to trauma, and predispose to the development of complications. Elderly patients have decreased muscle mass, chest wall recoil, and cough strength, all of which contribute to increased risks of aspiration, atelectasis and pneumonia after injury, regardless of the site of trauma.

The impact of aging on the cardiovascular system is profound in the trauma patient. The heart stiffens with age, resulting in diastolic dysfunction. Older patients exhibit a blunted chronotropic response that may be exacerbated by pharmacologic beta blockade or other rate controlling

agents. These patients cannot augment cardiac output and instead compensate for hemorrhagic shock by increasing systemic vascular resistance. Vital signs that are interpreted as normal in young patients may reflect relative hypotension and decreased end organ perfusion in the elderly, particularly in those with baseline hypertension. Whereas hypotension is defined  $<90$  in younger trauma patients, systolic blood pressures  $<110$  are associated with increased mortality in the elderly trauma patient.<sup>5</sup> This is particularly important in solid organ injuries where episodes of hypotension predict failure of non-operative management.

When assessing older trauma patients with altered mental status, it is challenging to determine if neurologic deficits are due to injury, pharmacologic agents, or baseline cognitive dysfunction. This may delay prompt recognition of injury or complications. Elderly patients are at increased risk of delirium and the high mortality associated with this complication.

Renal cell mass is lost with age, leading to decreased glomerular filtration rate which complicates pharmacokinetics, increases the risk of acute kidney injury (AKI) and impairs recovery to baseline renal function. Urinary tract infections (UTI) are a risk factor for trauma, particularly falls. A study of elderly trauma patients identified 11% with UTI on admission and a further 18% with asymptomatic bacteria.<sup>6</sup> The development of UTI after trauma admission is associated with mortality and this risk increases with increasing age.<sup>7</sup>

The proliferation of anticoagulation for arrhythmias and thromboembolic disease has resulted in an increasing number of elderly patients presenting with coagulopathy. Practitioners should be alert for occult bleeding, particularly within closed compartments like the skull, and clinicians must consider prophylactic pharmacologic reversal prior to obtaining CT in geriatric trauma patients.

Finally, due to impaired thermoregulation, elderly patients may present with hypothermia despite being found indoors. While the degree of temperature derangement is not as profound as with environmental exposure, hypothermia complicates and worsens outcomes from trauma in elderly patients.<sup>8</sup>

## COMORBIDITIES & FRAILITY

Three of four people over 65 have at least one chronic illness, and the number of comorbidities rises with age.<sup>9</sup> Recent work in emergency general surgery demonstrates that certain combinations are more lethal than others. Hypertension, arrhythmias and fluid & electrolyte (FEN) disorders are the most common and increase with age whereas coagulopathy & FEN disorders confer the highest increased mortality risk.<sup>10</sup> Elderly trauma patients cannot be managed without considering their chronic diseases and socioeconomic features contributing to their disability.<sup>11</sup>

The physiologic changes associated with aging and comorbidities are not equally distributed by age. Frailty is a concept that captures physiologic decline better than numeric age alone. Defined as a condition of decreased physiologic reserve and impaired ability to respond to stressors, frailty is both a risk factor for – and a predictor of – poor outcomes. Frail elderly trauma patients have a 25% mortality one year after injury; they are more likely to develop complications and require a prolonged length of stay or discharge to a facility.<sup>12</sup> Because they lack the physiologic robustness to tolerate a complication, frail patients have higher rates of failure to rescue.<sup>13</sup> Recognizing frailty in the elderly trauma population is critical because it allows clinicians to identify patients at high risk of adverse outcomes, intervene promptly, and achieve rescue. It may also play a role in determining futility of care.

There are multiple instruments used to calculate frailty, but there is no consensus on which model is best used across various clinical settings.<sup>14</sup> Although the initial frailty index consisted of 50 preadmission variables, the modified frailty index (mFI) employs 11, including a measure of functional status. Patients who are dependent prior to injury have a worse prognosis with increased postoperative complication rates and mortality compared to independent patients. The mFI has been used to identify high risk elderly trauma patients.<sup>15</sup> To guide conversations with patients and families regarding prognosis and to assist in determining futility, Zhao et al developed a geriatric trauma outcome score consisting of age, injury severity score (ISS) and need for blood transfusion, which predicts risk of hospital mortality.<sup>16</sup> Comorbidities, frailty and the geriatric trauma outcome score can be incorporated into the decision-making process with older trauma patients.

## MECHANISM OF INJURY

Ground level falls are the most common mechanism of injury among all trauma patients, and this is driven by the overwhelming number of elderly patients; greater than 1 in 4 elderly people fall each year.<sup>17</sup> The risk of fall increases with impaired mobility, altered sensorium, medication effects, and recent hospitalizations, all of which are prevalent in the older population. Falls are a risk factor for future falls and frequently herald a patient's physiologic decline and loss of independence. Despite the low energy mechanism, mortality may be as high as 7% for falls requiring admission, and only 50% of these patients are alive at one year.<sup>9</sup>

Motor vehicle crashes are common in elderly patients, with the risk of fatal collision rising with age. As the number of elderly drivers increases, we can anticipate more injuries.<sup>14</sup> The elderly are also at risk of being struck as pedestrians. In New York City patients 65 years and older comprise 1/3 of all pedestrian deaths.<sup>18</sup>

Other causes of injury in the older population include

suicide and abuse. The overall incidence of suicide is higher in the elderly than in the general population. Nearly three quarters are due to firearms, which carry a high mortality.<sup>19</sup> The functionally dependent status of many elderly patients puts them at risk for abuse. While this may present as assault, abuse also takes the form of neglect, with patients found emaciated or dehydrated. Identifying abuse often requires a high level of suspicion.

## PATTERNS OF INJURY

Several common injury patterns warrant special attention in the elderly.

### Rib fractures

While rib fractures may be well tolerated in younger patients, as few as two rib fractures in the elderly increases the risk of pneumonia and mortality, and the risk rises with the number of fractures. Pain leads to chest wall splinting, decreased alveolar recruitment, and impaired cough which may progress to pneumonia. Rib fracture management is based on multimodal pain control and aggressive pulmonary toilet. Narcotics have a narrow therapeutic window in the elderly with somnolence and respiratory depression worsening pulmonary toilet. Acetaminophen, gabapentin and pregabalin can improve pain control while minimizing narcotics or the nephrotoxic non-steroidal anti-inflammatories (NSAIDs). Local analgesia with epidural or erector spinae blocks augment pharmacologic pain control. Pulmonary toilet consists of induced coughing, incentive spirometry or flutter valve devices to improve alveolar recruitment, and early mobilization. Aggressive pulmonary toilet and multimodal analgesia are resource-intensive therapies, but they improve outcomes. Our institution adopted a protocol whereby all patients over 65 years with 2 or more rib fractures are admitted to our trauma ICU. We observed improved outcomes with decreased need for intubation (43% to 14%) and decreased mortality (24% to 9%).

### Hip & Pelvic fractures

Hip fractures in the elderly have a 30% one-year mortality. Early repair of these fractures is warranted as delays beyond 48 hours are associated with increased risk of death.<sup>20</sup> Ironically, attempting to optimize medical status prior to operation may instead deplete physiologic reserves and worsen outcomes. Elderly patients have a high incidence of pelvic fractures, and even minor injury patterns may precipitate bleeding. Pelvic hematomas may be out of proportion to the severity of fractures due to poor tissue integrity with loss of tamponade effect as well as the prevalence of anticoagulation. Clinicians should have a low threshold to obtain CT imaging, reverse anticoagulation, and pursue interventional radiology to address active bleeding. Pelvic fractures in the elderly are best managed in trauma centers.

### Traumatic brain injury

It is difficult to differentiate chronic cognitive decline from acute altered mental state due to trauma in an elderly patient; thus, a high level of suspicion is mandatory. Cortical atrophy develops with age, increasing the risk of bridging vessel rupture and intracranial bleeding from even minor mechanisms; anticoagulation increases the risk of intracranial hemorrhage as much as 7–10 fold.<sup>21</sup> As with pelvic fractures, clinicians should have a low threshold to reverse anticoagulation, even prior to imaging.

## OUTCOMES & GOALS OF CARE

While all trauma patients are at risk for developing complications, elderly trauma patients are more likely to develop these adverse events and less likely to tolerate them. Failure to rescue from complications is one reason for higher mortality in elderly trauma patients. For those patients who do survive, the traumatic injury may be a sentinel event that precipitates a loss of function and independence. Patients who deplete their physiologic reserve during recovery may fail to achieve their pre-injury functional status and progress to a chronic disease state.<sup>12</sup>

Despite the challenges of managing elderly trauma patients, there need not be therapeutic nihilism – we can have a positive impact. It is important to recognize outcomes beyond mortality that are valuable to patients and families. Identifying goals of care early in the hospital course includes setting realistic expectations regarding prolonged recovery, anticipated complications, and potential loss of function or independence. Geriatric and palliative care specialists play an important role in caring for trauma patients. Geriatric medicine specialists can optimize management of comorbidities and medications, and the implementation of a multidisciplinary team approach has demonstrated improved outcomes in frail elderly trauma patients.<sup>22</sup> Early involvement of palliative care services improve clinician and family consensus around goals of care. Palliative care is associated with decreased health care utilization by trauma patients at the end of life.<sup>23</sup>

## CONCLUSIONS

The incidence of elderly trauma is increasing. Severity of injury may be underappreciated in elderly patients due to low energy mechanisms, injury patterns and blunted physiologic response to injury, resulting in under-triage to trauma centers, delayed recognition of complications and increased mortality. As a marker of physiologic reserve, frailty is a better prognostic factor than chronologic age. Because elderly patients are less able to tolerate injury or subsequent complications, clinicians should approach these patients with a high degree of suspicion and a low threshold to transfer to a higher level of care to achieve rescue. Trauma may be a

sentinel event leading to loss of function and independence, and this should be reflected in conversations that outline realistic expectations for patients and families.

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