Should Age Be a Factor to Change From a Level II to a Level I Trauma Activation?

Vanessa K. Shifflette, MD, Manuel Lorenzo, MD, Alicia J. Mangram, MD, Michael S. Truitt, MD, Joseph D. Amos, MD, and Ernest L. Dunn, MD

Background: Elderly trauma patients have a higher incidence of medical comorbidities when compared with their younger cohorts. Currently, the minimally accepted criteria established by the Committee on Trauma for the highest level of trauma activation (Level I) do not include age as a factor. Should patients older than 60 years with multiple injuries and/or a significant mechanism of injury be considered as part of the criteria for Level I activation? Would these patients benefit from a higher level of activation?

Methods: The National Trauma Data Bank was queried for the period of January 1, 1999, to December 31, 2008, for all trauma patients and associated injury severity score (ISS). The data abstracted were based on age and ISS.

Results: The National Trauma Data Bank contained 802,211 trauma patients. Seventy-nine percent were younger than 60 years, and 21% were older than 60 years. Our analysis shows that in all levels of injury, patients older than 60 years have an increased risk for morbidity and mortality. We found a threefold increase in morbidity and a fivefold increase in mortality among the older (age >60 years) population with a minor ISS. Elderly patients with a major ISS demonstrated a twofold increase in morbidity and a fourfold increase in mortality.

Conclusion: Patients with an ISS between 0 and 15 are often triaged to Level II activation. Our data would suggest that patients older than 60 years should be a criterion for the highest level of trauma activation.

Key Words: Age, Elderly, Trauma activation.

METHODS

The National Trauma Data Bank (NTDB) was queried for the period of January 1, 1999, to December 31, 2008, for all trauma patients and associated ISS. The data abstracted included age and ISS. The categories were divided into all trauma patients aged 60 years or younger and those aged older than 60 years. Patients younger than 13 years were excluded. The ISS category was further divided into minor (0–9), major (10–15), severe (16–24), and critical (>24). Within these populations, the percentage of morbidity and mortality associated with each age group was evaluated. Pearson correlation coefficients were obtained. A p value <0.05 was considered statistically significant.

RESULTS

For the 10-year period under review, the NTDB contained 802,211 trauma patients. The younger patient population with ages 13 years to 60 years made up 79% (635,232 individuals), whereas the older population with age >60 years accounted for 21% (166,979 individuals). The minor ISS (0–9) category showed a 1.5% versus 5% morbidity (p = 0.001) and 0.6% versus 5.9% mortality (p = 0.001) among the younger versus older trauma patients, along with a 0.6% versus 3.3% mortality (p = 0.001), respectively. The major ISS (10–15) category showed a 4.8% versus 10.4% morbidity (p = 0.001) and 1.4% versus 5.9% mortality (p = 0.001) among the younger versus older trauma patients, with a 1.5% versus 12% mortality (p = 0.001), respectively. The severe ISS (16–24) category had a 10.9% versus 16.4% morbidity (p = 0.001) and 4.3% versus 12% mortality (p = 0.001), respectively. The critical ISS (>24) category showed a 27.3% versus 28% morbidity (p = 0.0495) and 27.9% versus 41.3% mortality (p = 0.001; Table 1; Figs. 1 and 2), respectively. The percent distribution within each ISS category was found to be similar among each age group (Table 2).
The factors taken into consideration for morbidity can be seen in Table 3. The most prevalent complications included pneumonia and urinary tract infections (UTIs). The younger trauma population had a 21.7% rate of pneumonia and 12.1% rate of UTI; whereas the older trauma population had a 19.6% rate of pneumonia and 26.4% rate of UTI. The data also show the rate of renal failure to be 5.7% within the elderly patients and 2.9% among the younger patients.

**DISCUSSION**

Trauma patients who typically present with a severe or critical ISS get the highest level of trauma activation as established by the Committee on Trauma of the American College of Surgeons. As the data from the NTDB shows, the elderly trauma patients have a threefold increase in morbidity and a fivefold increase in mortality with minor ISS, whereas they have a twofold increase in morbidity and a fourfold increase in mortality with major ISS. This elderly trauma population with perceived similar injuries has a significantly higher morbidity and mortality than the younger trauma population. In the Major Trauma Outcomes study, elderly patients accounted for 30% of the unexpected deaths, despite representing only 8% of the study population.5,7 We think this subset of patients with an ISS of 0–15, which are usually triaged to a Level II activation, would benefit from being upgraded to the highest level of activation (i.e., Level I).

The physiologic response in the geriatric population can be confusing and can complicate the resuscitation of the trauma patient. Degenerative changes are present in all organ systems of the elderly patient. It has been demonstrated that

![Figure 1. Percentage of morbidity for ISS category.](image1)

![Figure 2. Percentage of mortality for ISS category.](image2)

<table>
<thead>
<tr>
<th>TABLE 1. NTDB Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISS Category</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Minor (0–9)</td>
</tr>
<tr>
<td>Major (10–15)</td>
</tr>
<tr>
<td>Severe (16–24)</td>
</tr>
<tr>
<td>Critical (&gt;24)</td>
</tr>
</tbody>
</table>

**TABLE 3. Morbidity for Trauma Patients**

<table>
<thead>
<tr>
<th>Complication</th>
<th>Age 13–60 yr (%)</th>
<th>Age &gt;60 yr (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDS</td>
<td>9.74</td>
<td>6.96</td>
</tr>
<tr>
<td>Aspiration pneumonia</td>
<td>4.12</td>
<td>4.51</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>4.95</td>
<td>5.55</td>
</tr>
<tr>
<td>Coagulopathy</td>
<td>4.67</td>
<td>3.42</td>
</tr>
<tr>
<td>Deep venous thrombosis</td>
<td>6.71</td>
<td>7.19</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>21.72</td>
<td>19.59</td>
</tr>
<tr>
<td>Renal failure</td>
<td>2.88</td>
<td>5.69</td>
</tr>
<tr>
<td>Skin breakdown</td>
<td>3.78</td>
<td>4.87</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>12.10</td>
<td>26.40</td>
</tr>
<tr>
<td>Wound infection</td>
<td>5.84</td>
<td>2.16</td>
</tr>
</tbody>
</table>

ARDS, acute respiratory distress syndrome.
the decrease in physiologic reserve may explain why older patients generally suffer worse outcomes when compared with a younger cohort. Elderly patients with no visible or minor injuries may be at risk for life-threatening complications secondary to their limited physiologic reserve. In a study by Sauaia et al., age >55 years was identified as an independent predictor of multiple organ failure. They felt that the baseline physiologic reserve of the trauma patients older than 55 years could explain why they are unable to meet the metabolic demands of severe trauma.

Older patients tend to have about half the cardiac output when compared with someone younger than 60 years. The geriatric patient typically has significant atherosclerotic cardiovascular disease that leads to stiffening of the myocardium and decreased sensitivity to circulating catecholamines. As a result, hypovolemia, pain, and anxiety would normally cause tachycardia in a young patient, but an older individual may have a blunted or absent response. These patients may be on cardiac medications (β-blocker, angiotensin-converting enzyme, or diuretic), which further adds to this blunted response.

We also need to recognize that an elderly patient does not have the normal baseline renal function. Lean body muscle mass decreases with age, leading to an underrepresented creatinine value. Decreasing renal mass and functional nephrons lead to a diminishing glomerular filtration rate. This inherently places the geriatric patient at an increased risk for renal failure, as evidenced by a twofold increase in renal failure in our study.

It is known that the older population typically has preexisting comorbidities. Milzman et al. showed that patients with preexisting disease are at an increased risk for fatal outcomes and require more resources with longer intensive care unit and hospital stays. On the other hand, Morris et al. showed that the preexisting conditions only increase the risk seen in the younger and moderately injured trauma patient. They based this on the fact that the older trauma patient with preexisting disease is already at such a high risk for mortality. Alexander et al. showed that geriatric patients with cardiopulmonary disease before their blunt chest trauma have a significant increased risk in complications and a longer hospital length of stay when compared with generally healthy geriatric patients.

Demetriades et al. showed that severe trauma to the head, chest, abdomen, and extremities increases significantly with advancing age groups. The incidence of spinal injuries and pelvic fractures drastically increases with age. A much lower impact of force is needed to injure the bony skeleton of an elderly patient compared with a younger one. A common injury found among elderly trauma victims is rib fractures. Elderly trauma patients who sustain blunt chest trauma with rib fractures demonstrate a higher mortality and morbidity rate than the younger patients with similar injuries. Despite lower indices of injury severity, Bergeron et al. showed a similar increase in mortality of elderly patients with rib fractures. Patients aged 65 years or older had five times the odds of dying when compared with those younger than 65 years. In another study, Demetriades et al. stated that age >70 years should be used as a criterion for trauma team activation, although they did not designate the level of activation. They found that a significant number of elderly trauma patients with severe injuries did not meet their standard criteria for trauma team activation.

Scalea et al. demonstrated that aggressive early definitive management of elderly trauma patients improved outcomes. The return to independent living is one outcome measured to justify the benefit of this aggressive care. Activation of the trauma team and early intensive monitoring, evaluation, and resuscitation of geriatric trauma patients improve survival.

As our population of elderly patients increases, this will have profound effects on all trauma centers. Increasing the level of trauma response based on age will demand more resources in terms of physician care. This may also result in an increased level of patient transfers to Level I trauma centers. Staffing and reimbursement issues will have to be addressed in the future as this elderly population increases.

Another issue to address is whether increasing the level of activation will result in better outcomes in the elderly population. This can only be answered with future prospective studies. Our hospital and other trauma centers have begun to address this issue. We have established an elderly trauma unit, in which patients are directly admitted to this unit, and the care is overseen and expedited by the general surgical trauma team. Comparing outcomes in this kind of specialty units versus normal patterns of care will be imperative in the future.

CONCLUSION

A review of the NTDB for elderly patients shows a significant increase in both morbidity and mortality with lower levels of injury. A high index of suspicion is imperative in the management of this age group. As the geriatric population continues to increase in proportion to the total trauma population, the elderly patients will consume more time from the acute care surgeon. Increasing the level of trauma response may allow for earlier resuscitative and definitive care of the elderly trauma patient, resulting in better outcomes. We think that a geriatric trauma patient with a lower ISS would benefit from the highest level of trauma activation. Future studies are needed to analyze the outcomes and efficacy of using age as a criterion for a Level I activation.

REFERENCES


**DISCUSSION**

Dr. Roxie Albrecht (Oklahoma City, Oklahoma): I would like to applaud the authors for their recognition of a rapidly approaching major issue for those of us who provide trauma care: how should we change our practice to provide the optimal care of the geriatric or elderly trauma patient?

Others have shown similar findings to this study. As we heard earlier, in the 2006 NSCOT study coauthored by Ellen MacKenzie, our Fitts lecturer Doctor Rivara, and President Jerry Jurkovich that after controlling for ISS and other variables like race and comorbidities injury mortality was associated with an increase in age.

The authors of this study have shown that with the use of the NTDB data that all categories of ISS have a higher morbidity and mortality in the elderly population.

Given these findings the authors believe that all injured patients greater than the age of 60 should benefit from the highest level of trauma activation at a trauma center.

I would argue that activation alone is not the answer. As they described in their discussion, optimal care of the elderly patient needs to be taught to all providers.

We need to provide care from the field through hospital admission to discharge to influence the outcome of these elderly patients.

Trauma systems need to enact the most recent CDC field triage decision scheme which recommends injured patients of age greater than 55 and patients with significant comorbidities are transported to trauma centers, despite their physiologic and major mechanisms of injury.

Once in the trauma center, elderly patients should be expediently and thoroughly evaluated with attention to adjunctive information to assess cardiovascular compromise and hidden signs of perfusion deficits, followed by early placement of monitoring devices if these deficits are present, as previously shown by Scalea and Demetriades.

Furthermore, the best practice in hospital care of the injured patient needs to be a multi-disciplinary approach as shown in the last slide and recommended by Lorenzo, Fallon and most recently suggested by Aurelio Rodriguez here in Pittsburgh.

Highest level of trauma activation may get more personnel to the bedside but it doesn’t guarantee recognition of the subtle signs of perfusion deficits in the elderly patient and appropriate timely care.

Trauma programs need to provide all trauma patient care providers education and guidelines unique to the evaluation and treatment of the elderly patient. I have several questions for the authors.

First, why did you pick Age 60 as your cutoff? Contemporary articles use age greater than 65 as the definition for the elderly patient. And, as I previously stated, the CDC has decreased the age greater than 55 as a recommendation for trauma center transport.

Did you control for any comorbidities in your analysis? And did you look at subsets of age such as 65 to 80 or greater than 80 to see if these findings were more striking in the old of the old patients?

Major activation criteria usually is reserved for patients needing urgent interventions. Could you glean from your data patients who had trauma center activation, what level of activation, and if there was an influence on intervention and outcome?

Did you exclude any patients other than the less than 13? And why I say this, in looking at other NTDB studies from a similar timeframe they had nearly 1.5 to 2 million datasets within their studies and you had 800,000.

Did you exclude patients with minor single system injuries such as isolated hip fractures, those with high mortality rates such as traumatic brain injuries, or other patients who arrived dead?

And, finally, in 2008 a Journal of Trauma study by Kardooni showed that some hospitals submitted patient data sets to the NTDB that did not include any complication data.

© 2010 Lippincott Williams & Wilkins
or submitted data regarding only the most common complications such as DVT, pneumonia and UTI.

If one eliminates those datasets that only had partial data, the rates of complications are significantly different. Did you look to see if your findings held if you eliminated patients from centers that submitted no complications or only partial datasets?

I want to thank, again, the association for allowing me to discuss this paper and the authors for submitting it.

**Dr. Vanessa K. Shifflette (Dallas, Texas):** Doctor Albrecht, I would like to say thank you for your comments and your questions. I will try to answer as many of them as possible.

Your first question was why did we choose age greater than 60. We did a review of the literature, and as you stated, the majority of articles define the elderly patient at 65 years of age; some articles define elderly as age greater than 55. Our institution decided to arbitrarily assign the elderly trauma patient to a chronological age of 60. As you know, we start seeing the physiological effects of aging at the age of 60, and wanted to be as inclusive as we could.

For your second question, did we control for any comorbidities in our analysis and did we look at any other subsets for age? We did not control for any comorbidities while reviewing the data in the National Trauma Data Bank. The idea for further dividing age into different subsets, such as 65 to 80 or greater than 80, is a good idea; one that we did not analyze. This would be another aspect to look at in the future. By evaluating different subsets, we may define a more specific age for increasing mortality and morbidity in the elderly trauma patient.

I do not believe the National Trauma Data Bank (NTDB) has the data for which patients underwent trauma center activation and what level of activation. The data within the NTDB accounts for trauma patients at all institutions irrespective of their level. For our data set, we only evaluated those trauma patients designated for a Level I or Level II trauma center.

Another question you asked is regarding our 802,211 total number of patients. As you stated, other NTDB studies have shown about 2 million datasets within a similar timeframe. When we did our review of the NTDB, we found around 2.8 million patients. If you narrow your search to only the Level I and Level II trauma centers, the dataset falls to about 1.1 million. We then narrowed our search to patients older than the age of 13, had a logged injury severity score, and a disposition at discharge. With these criteria, we found that the total number of trauma patients was 802,211. We did not exclude patients with minor single system injuries.

As for your last question, the NTDB is an invaluable resource for our own research studies; and yet, also a limitation to our study. This resource is not always perfect, with centers providing incomplete or partial data sets. In regards to your last question, we did not analyze the data after eliminating patients from centers with no complications submitted or partial data sets.