Geriatric Trauma

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Disclosures

Dr. Hustey does not have a significant financial relationship to report
Special thanks to:

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Associate Director of Clinical Research
Wayne State University Department of EM
Detroit, Michigan
Objectives

• Discuss physiologic changes associated with aging and how they can impact trauma care

• Discuss pitfalls in the assessment and management of geriatric trauma patients
74 yo female restrained MVC. Brief LOC and slightly confused.

Initial VS: 114/72, p 84, r 22, p. ox 97%


- Does this represent major trauma?
- Is this patient hemodynamically stable?
- What are your concerns?
82 yo male h/o dementia and COPD, fell while walking and couldn’t get up. Initially c/o mild generalized weakness. Exam: 4+/5 strength upper extremities, otherwise -. Pt. states “let me go”.

• Is this patient at risk for significant injury?
• What are your concerns?
• Does this patient need C-spine immobilization?
• What further evaluations should be done?
What’s Different About Geriatric Trauma?
These Patients are Unique

- Physiologically
- Anatomically
- Co-morbidities
- Medications
Physiologic/Anatomic Aspects of Aging

- Less pulmonary reserve
  - Chest wall less compliant
  - Decreased vital capacity
  - Decreased diffusion capacity
  - Decreased response to CO2, O2 changes
Physiologic/Anatomic Aspects of Aging

- Reduced renal function
  - Decrease in renal mass
  - Decrease in renal blood flow
  - Less reserve to cope with acid/base and volume disturbances
Physiologic/Anatomic Aspects of Aging

Cerebral anatomy

- Atrophy
  - More room in cranial vault
  - Shearing of bridging vessels
  - ? Delayed neurological manifestations of SDH

- Cognitive impairment/dementia
Physiologic/Anatomic Aspects of Aging

• Musculoskeletal
  - Progressive trabecular bone loss
  - Increased fragility

• Dermal integrity
  - Atrophy of all skin layers
Cardiovascular

• Decrease in cardiac index
• Catecholamine receptor desensitization
  - Decreased inotropic/chronotropic response
Cardiovascular

- Hypertension
  - Decreased arterial compliance

“normal” BP may be hypotensive
Consequences

- More severe injuries, “minor” mechanisms
- More likely to decompensate
  - Less physiologic reserve
- Delayed recognition of complications
Comorbidities

- Comorbidities present in:
  - 40% between 65y and 74y
  - 65% between 75y and 84y
  - 90% older than 85y
# Impact of Co-Morbidity on In-Hospital Mortality*

Based on a study of 65,743 subjects in a United Kingdom trauma registry. Adjusted for age, gender and injury severity score.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prevalence (%)</th>
<th>Odds Ratio†</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>29.8</td>
<td>7.0</td>
<td>5.1, 9.6</td>
</tr>
<tr>
<td>Respiratory</td>
<td>19.0</td>
<td>5.6</td>
<td>4.9, 8.1</td>
</tr>
<tr>
<td>Endocrine</td>
<td>9.0</td>
<td>4.5</td>
<td>3.1, 6.5</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>8.3</td>
<td>3.3</td>
<td>2.2, 5.1</td>
</tr>
<tr>
<td>Neurological</td>
<td>4.7</td>
<td>5.0</td>
<td>2.8, 9.1</td>
</tr>
<tr>
<td>Alcoholism</td>
<td>3.2</td>
<td>10.2</td>
<td>5.0, 20.7</td>
</tr>
<tr>
<td>Dementia</td>
<td>2.3</td>
<td>5.9</td>
<td>3.6, 9.7</td>
</tr>
<tr>
<td>Psychosis</td>
<td>2.3</td>
<td>4.9</td>
<td>2.0, 12.0</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>1.9</td>
<td>5.2</td>
<td>2.5, 10.6</td>
</tr>
<tr>
<td>Malignancy</td>
<td>1.7</td>
<td>7.3</td>
<td>4.0, 13.3</td>
</tr>
<tr>
<td>Renal</td>
<td>0.9</td>
<td>22.4</td>
<td>11.6, 43.3</td>
</tr>
<tr>
<td>Hematological</td>
<td>0.6</td>
<td>5.3</td>
<td>1.8, 15.6</td>
</tr>
</tbody>
</table>

*Adapted from: Hollis et al. J Trauma 2006;61:1255-60.*
Medications

- B-blockers
- Ca\(^+\) channel blockers
- Warfarin
- Clopidogrel
- Direct thrombin inhibitors
  - Dabigatran, etc.
Guidelines?

EAST I
EAST II
• EAST I

• Focused on development of evidence-based guidelines

• Two areas
  - Triage
  - Resuscitative interventions
EAST Guidelines

• Limited by lack of evidence
  - Not much “good literature”
EAST Guidelines

Key points

• Older patients at risk for under-triage
• Age alone does not predict poor prognosis
• Comorbidities and post-injury complications adversely affect outcome

EAST II

• 10 Years Later
  - More literature
  - Better Evidence

• 400 Medline citations
  - 90 references selected for constructing guidelines

• Guideline development in three broad areas
  - Triage
  - Correcting coagulopathy
  - Supraphysiologic resuscitation
• **Key points: Triage**

- **Lower threshold for field triage to trauma center if elderly + any comorbidities**

- **Lower threshold for trauma team activation if evaluated at trauma center**

- **Trauma center care and ICU if elderly and severe anatomic injury (one or more body systems with AIS>2)**
• **Key points: Supraphysiologic resuscitation**

- Base deficit measurements can be useful in determining status of initial resuscitation and mortality

• Consider ICU if initial deficit is - 6 mEq/L or less

- Insufficient evidence regarding *indiscriminate* use of invasive CV monitoring
• **Key points: Correcting coagulopathy**
  - Patients taking systemic anticoagulants
    • Assess coagulation profile ASAP
    • If head injury then CT ASAP**
  - Traumatic ICH on warfarin: therapy to correct INR towards normal within 2 hours

Under-Triage
The Problem of Under-Triage

False Sense of Security

- delay in appropriate management
- increased risk of poor outcome
The Problem of Under-Triage

Why False Sense of Security?

- Less significant mechanism of injury
- “Normal" vital signs
- Lack of appreciation for co-morbidities and medication effects
Trauma in the Very Elderly: a Community-Based Study of Outcomes at Trauma and Non-trauma Centers

Meldon et al J Trauma 2002; 52:79
Methods

- Countywide registry review
- Severely injured older trauma patients
  - > 80 years old
  - ISS 21-45

Meldon et al. J Trauma
2002;52:79
Key Points

Older patients disproportionately cared for in non-trauma centers

Non trauma center = greater mortality
- 56% survival trauma center
- 8% survival non-trauma center

Meldon et al J Trauma 2002; 52:79
Triage of Elderly Trauma Patients: A Population-Based Perspective

- Registry review
- Under triage defined as ISS > 15 going to non-trauma center
- 32.8% (80/244) under triage
Effect on Outcome of Early Intensive Management of Geriatric Trauma Patients

Question

• Does lowering the threshold for trauma team activation and implementing early aggressive monitoring and resuscitation improve outcomes?
Rationale

• Despite significant injuries older patients often do not exhibit standard criteria for trauma team activation
Methods

• Trauma registry review
  - Patients 70 y/o or older
  - ISS > 15

• Before and after study
  - Before – usual care
  - After – age 70 = TTA + aggressive monitoring and resuscitation protocol
Key Points

Mortality

• Usual care 53.8%
• Intervention 34.2%

• What intervention made the difference?
  - TTA?
  - Resuscitation protocol?
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

![Graph showing mortality rates by injury severity score and age group.]

<table>
<thead>
<tr>
<th>ISS</th>
<th>Age 13–60 yr (%)</th>
<th>Age &gt;60 yr (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor</td>
<td>62.5</td>
<td>62.5</td>
</tr>
<tr>
<td>Major</td>
<td>13.6</td>
<td>12.3</td>
</tr>
<tr>
<td>Severe</td>
<td>12.5</td>
<td>14.4</td>
</tr>
<tr>
<td>Critical</td>
<td>11.4</td>
<td>10.8</td>
</tr>
</tbody>
</table>

Recognizing Hypoperfusion

And supraphysiologic resuscitation
Why Base Deficit?

Signs of shock easy to miss

- “Normal” vital signs
- “Unimpressive” physical exam findings
Serum Lactate and Base Deficit as Predictors of Mortality in Normotensive Elderly Blunt Trauma Patients

David W. Callaway, MD, Nathan I. Shapiro, MD, MPH, Michael W. Donnino, MD, Christopher Baker, MD, and Carlo L. Rosen, MD
Association Between a Geriatric Trauma Resuscitation Protocol Using Venous Lactate Measurements and Early Trauma Surgeon Involvement and Mortality Risk

Question

- Is lactate-guided therapy + early trauma surgeon involvement = lower mortality through early recognition of shock?
Methods

• Initial + serial lactate levels
• Lactate $\geq 2.5$ mM identified as OH
  - more “aggressive care” including early trauma surgeon involvement and admit to trauma service
• Followed compliance with protocol and change in mortality over time
Key Points

Occult hypoperfusion (= otherwise unrecognized shock)?

• 21% of patients

• significant decrease in mortality over time as protocol compliance improved
Take Home Message

• Can’t rely on “normal” vital signs in older trauma patients
• Lactate measurements useful
• Early recognition and intervention is key to better outcomes
Let’s revisit:
74 yo female restrained MVC ? LOC ? confused.
VS: 114/72, P 84, R 22, POx 97%
Moderate tenderness lower chest/upper abd.
Extremities nl. Neuro nonfocal.

- Does this represent major trauma?
- Is this patient hemodynamically stable?
- What are your concerns?
Correcting Coagulopathy
Prothrombin Complex Concentrate (PCC) vs. FFP

• Warfarin inhibits vitamin K dependent clotting factors
  - IV, VII, IX, X

• 4 Factor PCC
  - IV, VII, IX, X

• Why not use FFP?
Prothrombin Complex Concentrate (PCC)?

PCC vs. FFP

- FFP requires thawing (PCC does not)
- FFP requires ABO compatibility (PCC does not)
- FFP contains same factors, but at levels that are less reliable
- **Increased risk of thrombotic events with PCC**
  - PE, limb ischemia, CVA
<table>
<thead>
<tr>
<th>Group</th>
<th>Median INR (IQR) Baseline</th>
<th>Median INR (IQR) 30 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interventional procedure</td>
<td>2.8 (2.3–3.8)</td>
<td>1.2 (1.1–1.3)</td>
</tr>
<tr>
<td>Acute bleeding</td>
<td>4.8 (3.1–7.8)</td>
<td>1.1 (1.0–1.2)</td>
</tr>
<tr>
<td>All</td>
<td>3.2 (2.4–5.2)</td>
<td>1.2 (1.0–1.3)</td>
</tr>
</tbody>
</table>
Injury Mechanisms

Injury mechanisms differ between older and younger patients

Most common geriatric

• Falls
• Motor vehicle crashes (MVCs)
• Burns
Falls

- Most common cause of injury
- Low level falls often serious
- Elderly more likely to die as result of fall

  - Deaths from falls >85 y exceed MVC deaths 18-19 y
Falls

Low level mechanism = under triage

- C-spine Injury
- Head Injury
- Hip Fractures
- Other
C-Spine Injury
Older Patients High Risk

- Canadian C-spine Rule
  - Age over 65 is a high risk criteria and mandates imaging

Stiell et al. JAMA 2001;286:1841
# Injury Patterns in Geriatric Patients

<table>
<thead>
<tr>
<th>Injury</th>
<th>Geriatric Frequency, No. (%) (n=2,943)</th>
<th>Nongeriatric Frequency, No. (%) (n=30,443)</th>
<th>Relative Risk* (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occipital condyle</td>
<td>2 (0.1)</td>
<td>18 (0.1)</td>
<td>1.15 (0.27–4.95)</td>
</tr>
<tr>
<td>C1</td>
<td>26 (0.9)</td>
<td>79 (0.3)</td>
<td>3.40 (2.19–5.29)</td>
</tr>
<tr>
<td>C2 nonodontoid</td>
<td>52 (1.8)</td>
<td>141 (0.5)</td>
<td>3.81 (2.78–5.23)</td>
</tr>
<tr>
<td>C2 odontoid</td>
<td>40 (1.4)</td>
<td>51 (0.2)</td>
<td>8.11 (5.37–12.3)</td>
</tr>
<tr>
<td>C3</td>
<td>6 (0.2)</td>
<td>44 (0.1)</td>
<td>1.41 (0.60–3.31)</td>
</tr>
<tr>
<td>C4</td>
<td>6 (0.2)</td>
<td>78 (0.3)</td>
<td>0.80 (0.35–1.82)</td>
</tr>
<tr>
<td>C5</td>
<td>17 (0.6)</td>
<td>160 (0.5)</td>
<td>1.10 (0.67–1.81)</td>
</tr>
<tr>
<td>C6</td>
<td>23 (0.8)</td>
<td>219 (0.7)</td>
<td>1.09 (0.71–1.67)</td>
</tr>
<tr>
<td>C7</td>
<td>27 (0.9)</td>
<td>220 (0.7)</td>
<td>1.27 (0.85–1.89)</td>
</tr>
<tr>
<td>Total fractures</td>
<td>199 (6.8)</td>
<td>819 (3.3)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spinal cord injuries</th>
<th>Geriatric Frequency, No. (%) (n=2,943)</th>
<th>Nongeriatric Frequency, No. (%) (n=30,443)</th>
<th>Relative Risk* (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cord injuries</td>
<td>8 (0.3)</td>
<td>61 (0.2)</td>
<td>1.36 (0.65–2.83)</td>
</tr>
</tbody>
</table>

# Use of Plain Radiography to Screen for Cervical Spine Injuries

<table>
<thead>
<tr>
<th>Spine Level</th>
<th>No. of Injuries in All Patients</th>
<th>No. of Missed Injuries</th>
<th>% of Injuries Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>105</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>C2 (nonodontoid)</td>
<td>194</td>
<td>6</td>
<td>3.1</td>
</tr>
<tr>
<td>Odontoid</td>
<td>92</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>C3</td>
<td>51</td>
<td>2</td>
<td>3.9</td>
</tr>
<tr>
<td>C4</td>
<td>84</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>C5</td>
<td>179</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>C6</td>
<td>242</td>
<td>10</td>
<td>4.1</td>
</tr>
<tr>
<td>C7</td>
<td>228</td>
<td>7</td>
<td>3.1</td>
</tr>
<tr>
<td>Interspinous</td>
<td>231</td>
<td>3</td>
<td>1.3</td>
</tr>
</tbody>
</table>
82 yo male fell while walking. Initially c/o mild weakness. Exam: 4+/5 strength upper extremities, otherwise -. 

What is this?
Central Cord Syndrome

- Forced hyperextension
  - falls
- Upper motor neuron weakness
  - Arms > legs
  - Distal > proximal
- Radiographs -
- Older patients higher risk
Head Injury

- Subdural Hematoma - Higher risk
- Cerebral atrophy
- Bridging vessel fragility
- Anticoagulant use

Canadian head CT rule: age 65+ considered high-risk criteria

- Stiell et al. Lancet 2001;5:357
Subdural Hematoma

- Common in geriatric trauma
- Risk 5x higher 75-84 year old
- Risk 13x higher > 85-year-old
Presentation

• May be subtle
  - Cerebral atrophy - delayed symptoms
  - Dementia may interfere with dx
  - Can deteriorate rapidly

• Subacute SDH: worsening headache 7-14 d after trauma
Hip Fractures

• Common in older trauma patients
  - Falls***

• Clinical exam varies widely
Hip Injury

- 82 year old female falls on a wet floor, presents with severe left hip pain. Physical exam shows left leg shortening with external rotation

- What is this injury?
Femoral Neck Fracture
Normal Hip
Hip Injury

- 74 year old male restrained driver head on MVC. Physical exam: Right hip in flexion with internal rotation of LLE

- What is this injury?
Hip Dislocation
Hip Injury

- 92 year old s/p fall on loose carpet complains of right hip pain. No deformity. Tender to palpation right hip. Unable to weight bear. Xrays – no fracture or dislocation.

- What next?
Hip Injury

A Orthopedic surgery consult in ED
B Crutches and d/c
C More imaging
D Foley and Nursing Home
Acetabular Fracture
Additional Management Considerations
Other Things to Consider

- Stabilize and transfer early to trauma center
- Once at hospital: remove c-collar when c-spine is cleared
- Off backboard as soon as possible
- End of life issues
  - Advanced directives
Geriatric Trauma Module

www.cchhs.net/comet/gem
Conclusion

• Older patients at-risk for poor outcomes
  - physiology of aging
  - pre-existing medical conditions
  - poor recognition of shock
  - inappropriate triage

• Appropriate management strategies can greatly improve outcomes
Questions?

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