I have no financial disclosures to report in my presentation.
Objectives:

• The learner will understand the physiological decline that impacts traumatic injury and emergency general surgery outcome in the elderly

• The learner will understand risk assessment and models of care which improve outcomes in trauma and emergency general surgery in the elderly

Demographics and Outcomes
Definition of Geriatric [The Elderly]

• Age 65 and over*

*Definition used in most studies

Aging Population and Surgery

• Starting in 2012: 10,000 people will turn 65 each day
• In 10 years: 20% of the population will be ≥ 65 years
• By 2050: ~ 20 million will be ≥ 85 years
• More than 50% of persons ≥ age 65 years will have some surgical procedure in the remainder of his or her lifetime
• Currently, 15% of the population, accounts for 38% of procedures, or 19.2 million/ year
• Overall traditional surgical outcomes are worse in older adults
The Elderly: **DEPENDENCY** on the health care system

_Elderly (≥ 65)_

- On average the elderly experience three chronic conditions
- 20% risk for hospitalization per year
- Nearly 2/3 of ICU beds are occupied by the elderly
- Co-morbidities decrease physiologic reserve and alter the body’s ability to resist external insults
- Trauma, sepsis, GI bleeding, cardiac arrest - all shown to have an age-related increased mortality
The Elderly: A unique trauma cohort

- Elderly constitutes 28% of traumatic deaths
- Geriatric trauma accounts for 90% of all trauma expenditures
- Falls represent the most common cause of injury in the elderly - 75% of all fall-related deaths
  - Annual fall incidence
    - 33% for > 65 years of age; 50% > 80 years of age
    - Higher injury severity, higher mortality (up to 70% higher)
    - Older elderly (i.e. > 75 years old fare worse than younger elderly (i.e. 65-75 years old)
  - Higher % of the elderly on anticoagulation
    - Cardiac stents; atrial fibrillation; prior CVA

Mohanty, Rosenthal, Russell et al. JACS. 2016; 222(5):930-947

Alterations to Physiology
Cardiovascular:

<table>
<thead>
<tr>
<th>Physiologic alteration</th>
<th>Clinical Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased sympathetic response</td>
<td>Labile BP</td>
</tr>
<tr>
<td>Decreased venous compliance, decrease in preload</td>
<td>Susceptibility to hypotension</td>
</tr>
<tr>
<td>Baroreceptor response impaired</td>
<td>Susceptibility to volume overload</td>
</tr>
<tr>
<td>Cardiac diastolic dysfunction</td>
<td>Exaggerated decline in cardiac function</td>
</tr>
<tr>
<td></td>
<td>Inadequate cardiac filling</td>
</tr>
</tbody>
</table>

Mohanty, Rosenthal, Russell et al. JACS. 2016; 222(5):930-947
### Alterations to Physiology

**Pulmonary:**

<table>
<thead>
<tr>
<th>Physiologic alteration</th>
<th>Clinical Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased pulmonary arterial pressure</td>
<td>Increased A-a O2 gradient</td>
</tr>
<tr>
<td>Decreased response to hypoxia and hypercarbia</td>
<td>Susceptibility to hypercarbia and hypoxemia</td>
</tr>
<tr>
<td>Decreased muscle mass and lung capacity</td>
<td>Susceptibility to residual anesthetic effects</td>
</tr>
<tr>
<td>Decreased cough reflex and esophageal motility</td>
<td>Increased work of breathing</td>
</tr>
<tr>
<td></td>
<td>Increased dead space ventilation</td>
</tr>
<tr>
<td></td>
<td>Aspiration risk</td>
</tr>
</tbody>
</table>

Mohanty, Rosenthal, Russell et al. JACS. 2016; 222(5):930-947

---

### Alterations to Physiology

**Other system dysfunction:**

<table>
<thead>
<tr>
<th>Physiologic alteration</th>
<th>Clinical Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nervous system:</strong></td>
<td>Increased risk of postoperative delirium; cognitive impairment; depression</td>
</tr>
<tr>
<td>Decreased neurotransmitters</td>
<td>Impaired intraoperative hyperglycemia</td>
</tr>
<tr>
<td><strong>Endocrine system:</strong></td>
<td>Decreased drug clearance</td>
</tr>
<tr>
<td>Impaired glucose tolerance</td>
<td>Susceptibility to AKI</td>
</tr>
<tr>
<td><strong>Hepatic/renal system:</strong></td>
<td>Increased risk of hypothermia</td>
</tr>
<tr>
<td>Altered drug metabolism</td>
<td></td>
</tr>
<tr>
<td>Decreased renal mass</td>
<td></td>
</tr>
<tr>
<td><strong>Thermoregulation:</strong></td>
<td></td>
</tr>
<tr>
<td>Decreased muscle mass</td>
<td></td>
</tr>
<tr>
<td>Decreased vascular reactivity</td>
<td></td>
</tr>
</tbody>
</table>

Mohanty, Rosenthal, Russell et al. JACS. 2016; 222(5):930-947
Frailty: \textit{a syndrome}
Cognitive, Physical, Functional

[psychological, social]

From: Fried LP a, Walston J. In Hazzard 4th ed. 1998
Role of frailty on outcomes after a physiologic insult

British Journal of Surgery: 2016; 103:e52-e61

Geriatric Trauma
Challenges Facing Providers

- Geriatric Trauma is a growing concern
- Challenges identified:
  - Under triage
  - Lack of protocols
  - Post-discharge rehabilitation
  - Long-terms
  - Delirium
  - Polypharmacy

J trauma Acute Care Surg. 2015;78(6):1197-1209
Underutilization of Resources/Protocols

AAST Survey:
Please state how frequently your institution uses the following resources for geriatric trauma patients:

- Always or Often
- Sometimes
- Rarely or Never
- Don't Know

J trauma Acute Care Surg. 2015;78(6):1197-1209

Long Term Outcomes in Trauma Patients

- All adult trauma patients:
  - 54% of patients >65 years discharged to Skilled Nursing
  - Predictor of poor outcome:

Factors Leading to Poor Outcomes

In the AAST Survey, Respondents identified:
• Age-specific alterations in Response to Injury
• Frailty
• Anticoagulants
• Other Medications
• Delirium
• Medication Management

J trauma Acute Care Surg. 2015;78(6):1197-1209

ATLS: A universal survival approach [A→B → C → D → E]

• The Foundational algorithm
  • A - Airway maintenance AND cervical spine protection
  • B - Breathing AND ventilation
  • C - Circulation AND hemorrhage control
  • D - Disability: neurologic status
  • E - Exposure environment

The survival sequence:
• Primary Survey
  • A, B, C, D,E, and F, G
• Resuscitation
  • Adjuncts to primary survey and resuscitation
  • Consider need for patient transfer
• Secondary Survey
  • Adjuncts to the Secondary Survey
  • Reevaluation
• Definitive Care
Initial evaluation in the elderly: **AMPLE** history

- **Determine Medications that affect initial evaluation and care**
  - Anticoagulants: 15% of Geriatric trauma patients
    - Coumadin
    - Antiplatelet agents: e.g. ASA, Clopidogrel, etc.
    - Novel oral anticoagulants
      - Direct thrombin inhibitors
      - Factor XA inhibitors
  - Beta Blockers
  - ACE inhibitors

- **Consider common, acute, non-traumatic events that could complicate the patient’s presentation (e.g.):**
  - Acute coronary syndrome
  - Hypovolemia/dehydration
  - UTI
  - Pneumonia
  - ARF
  - CVA
  - Syncope

---

**Triage and Advanced Age**

- Injured elderly are less likely to receive care at a trauma center.
- Although elderly patients are injured by similar mechanisms as younger patients, the injury pattern, severity, **AND** sequelae are quite distinct, **AND** are associated with a higher mortality rate despite less severe injuries.

Trauma Service Activation in the Elderly

I. Old Age as a criteria for trauma activation
   • *J Trauma*. 2001; 51:754-757

II. Increase trauma activation is not equally beneficial for all elderly trauma patients
    • *J Trauma Acute Care Surg*. 2018;85:598-602

III. Improving Geriatric trauma: A small step towards a big problem
     • *J trauma Acute Care Surg*. 2016;81:162-167

---

Old Age as a Criterion for Trauma Team Activation

Demetrios Demetriades, MD, Jack Sava, MD, Kathleen Alo, RN, E. Newton, MD, George C. Feliciano, MD, James A. Murray, MD, Howard Belzberg, MD, Juan A. Asensio, MD, and Thomas V. Berge, MD

**Background:** Elderly trauma patients have been shown to have a worse prognosis than young patients. Age alone is not a criterion for trauma team activation (TTA). In the present study, we evaluated the role of age ≥ 70 years as a criterion for TTA.

**Methods:** The present study was a trauma registry study that included injured patients ≥ 70 years of age or older. Patients who died in hospital, were admitted to the intensive care unit (ICU) within 24 hours, or had a nonorthopedic operation were assumed to benefit from TTA.

**Results:** During a 7.5-year period, 883 elderly (≥ 70 years) trauma patients meeting trauma center criteria were admitted to our center. Overall, 223 patients (25%) met at least one of the standard TTA criteria. The mortality in this group was 50%, the ICU admission rate was 39%, and a nonorthopedic operation was required in 35%. The remaining 660 patients (75%) did not meet standard TTA criteria. The mortality was 16%, the need for ICU admission was 24%, and nonorthopedic operations were required in 10%. Sixty-three percent of patients with severe injuries (Injury Severity Score > 15) and 25% of patients with critical injuries (Injury Severity Score > 30) did not have any of the standard hemodynamic criteria for TTA.

**Conclusion:** Elderly trauma patients have a high mortality, even with fairly minor or moderately severe injuries. A significant number of elderly patients with severe injuries do not meet the standard criteria for TTA. It is suggested that age ≥ 70 years alone should be a criterion for TTA.

Key Points

• Injury IS more difficult to diagnose due to:
  • Altered sensorium
  • Chronic pain issues
  • Multiple comorbidities
• Lower energy impact can lead to serious injury

• Consider EARLY TRANSFER to trauma center
  • More use of evidence based practices
  • Higher use of diagnostic/therapeutic protocols

Demetriades et al. J Trauma 2001;51:754-757

Trauma Service Activation in the Elderly

• Elderly CAN experience significant injury in spite of a relatively trivial mechanism

• Physiologic response to injury often differ from that seen in younger patients
  • Altered baseline vital signs
  • Global decreased physiologic reserve
  • Pre-existing disease (HTN, CVD, CKD)
  • Medications (Beta blockers, anticoagulants)

• Alteration in mentation [at baseline - delirium /dementia]
  • Potential for lack of recognition of shock or traumatic brain injury

• These factors increase the risks for under triage by both EMS and the ED personnel.
  • To mitigate late recognition of significant injuries, a lower threshold for trauma team activation should be used for the elderly trauma patient
Table 3 - Relationship between Age Groups and ISS Groups, and Mortality, Hospital Length of Stay, and ICU Length of Stay in Total Study Cohort, Including Penetrating Injuries

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Variable</th>
<th>ISS &lt; 15 (%)</th>
<th>ISS of 15-29 (%)</th>
<th>ISS &gt; 30 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-45</td>
<td>Mortality</td>
<td>15:6,438 (0.2)</td>
<td>120:2,971 (4.2)</td>
<td>2101,877 (20.1)</td>
</tr>
<tr>
<td></td>
<td>ICU LOS</td>
<td>0.62 ± 1.87</td>
<td>3.75 ± 7.24</td>
<td>9.83 ± 12.80</td>
</tr>
<tr>
<td></td>
<td>Hospital LOS</td>
<td>4.70 ± 4.77</td>
<td>9.85 ± 11.15</td>
<td>17.48 ± 18.07</td>
</tr>
<tr>
<td>46-64</td>
<td>Mortality</td>
<td>26:3,154 (0.4)</td>
<td>101:1,209 (8.4)</td>
<td>67:020 (67.2)</td>
</tr>
<tr>
<td></td>
<td>ICU LOS</td>
<td>0.24 ± 3.39</td>
<td>4.18 ± 7.52</td>
<td>11.05 ± 11.91</td>
</tr>
<tr>
<td></td>
<td>Hospital LOS</td>
<td>5.77 ± 0.48</td>
<td>11.17 ± 11.98</td>
<td>19.21 ± 20.86</td>
</tr>
<tr>
<td>65+</td>
<td>Mortality</td>
<td>159:4,952 (3.2)^†</td>
<td>3.98:1,723 (18.7)^‡</td>
<td>16.13:37 (47.8)^‡</td>
</tr>
<tr>
<td></td>
<td>ICU LOS</td>
<td>0.85 ± 5.57</td>
<td>5.23 ± 6.67</td>
<td>9.18 ± 12.62</td>
</tr>
<tr>
<td></td>
<td>Hospital LOS</td>
<td>7.01 ± 0.55</td>
<td>11.98 ± 12.65</td>
<td>10.32 ± 17.42^‡</td>
</tr>
</tbody>
</table>

* Data are mean ± SD; ^† p < 0.001 vs. other age groups.
Post op complications in the Elderly *increase* in-hospital mortality

- The most common complications after surgery
  - BLEEDING
  - Incisional SSI
  - Pneumonia
  - Organ space infection
  - The need for emergency general surgery increases with age as does the rate of complications and mortality

Assessment tools - disease prognostication

• Geriatric trauma outcome score
  • Utilizes physiologic variables within the 1st 24 hours - correlates with mortality
• Trauma specific frailty risk index
  • Screens for frailty
  • Correlates to outcomes
• Trauma quality improvement program
  • Will generate an assessment tool
  • Standards and guidelines for geriatric care and palliative care for trauma patients

Typical injury severity calculators do not provide meaningful in prognostication in the elderly

Predictors of mortality and futility in the elderly
NSQIP Risk calculator ??
Elderly risk assessment tools in emergency general surgery

• Emergency general surgery specific frailty index: a validation study (2016)

• Review of risk assessment tools to predict morbidity and mortality in elderly surgical patients (2018)

• Preoperative assessment of surgical risk: creation of a scoring tool to estimate 1-year mortality after emergency abdominal surgery in the elderly patient (2016)
Table 3: Multivariate logistic regression model for 1-year mortality and associated variable weights

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR (95% CI)</th>
<th>ln (OR)</th>
<th>Approximate weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute kidney injury</td>
<td>4.26 (2.11-9.05)</td>
<td>1.668</td>
<td>2</td>
</tr>
<tr>
<td>ASA class ≥ IV</td>
<td>4.25 (2.13-8.49)</td>
<td>1.504</td>
<td>2</td>
</tr>
<tr>
<td>BMI &lt; 18.5 (ref: 18.5-24.9)</td>
<td>4.04 (1.07-15.28)</td>
<td>1.198</td>
<td>1</td>
</tr>
<tr>
<td>BMI ≥ 29 (ref: 18.5-24.9)</td>
<td>2.64 (1.33-5.24)</td>
<td>-1.186</td>
<td>1</td>
</tr>
<tr>
<td>Charlson score ≥ 4</td>
<td>3.97 (2.27-6.94)</td>
<td>1.586</td>
<td>1</td>
</tr>
<tr>
<td>Major operative severity</td>
<td>6.65 (1.92-21.28)</td>
<td>2.605</td>
<td>2</td>
</tr>
<tr>
<td>Serum albumin &lt; 3.5</td>
<td>2.17 (1.27-3.71)</td>
<td>-0.695</td>
<td>1</td>
</tr>
</tbody>
</table>

ASA = American Society of Anesthesiologists; BMI = body mass index; CI = confidence interval; OR = odds ratio.

Table 5: Distribution of 1-year mortality based on post-hoc emergency surgery mortality score

<table>
<thead>
<tr>
<th>Score</th>
<th>No. Survived (% of total)</th>
<th>No. Died (% of total)</th>
<th>One-year mortality, %</th>
<th>Level of Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>31 (100.00)</td>
<td>0 (0.00)</td>
<td>6-7</td>
<td>Low risk</td>
</tr>
<tr>
<td>1</td>
<td>508 (88.90)</td>
<td>8 (1.09)</td>
<td>92-68</td>
<td>High risk</td>
</tr>
<tr>
<td>2</td>
<td>77 (11.14)</td>
<td>36 (51.36)</td>
<td>32-48</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>24 (3.84)</td>
<td>31 (46.38)</td>
<td>24-58</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12 (1.92)</td>
<td>17 (25.59)</td>
<td>14-68</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7 (1.12)</td>
<td>15 (21.81)</td>
<td>04-100</td>
<td>Very high risk</td>
</tr>
<tr>
<td>6</td>
<td>1 (0.16)</td>
<td>16 (24.13)</td>
<td>04-100</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0 (0.00)</td>
<td>7 (100.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0 (0.00)</td>
<td>1 (100.00)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Geriatric Trauma Care: Interdisciplinary, Multidisciplinary, Co-management

- Geriatric outcomes are improved by a geriatric trauma consultation service
- Geriatric trauma service: a one year experience
- An evaluation of a proactive geriatric trauma consultation service
- Frailty screening and frailty pathways decrease length of stay, loss of independence, and 30 day readmission rate in frail geriatric trauma and emergency general surgery patients
- Frailty identification and care pathway: an interdisciplinary approach for older trauma patients
A Geriatric Trauma Institute Designation

- The Geriatric Trauma Institute: reducing the increasing burden of senior trauma care
- Retrospective evaluation of the impact of a Geriatric Trauma Institute on fragility hip fracture patient outcomes
- Improvement in geriatric trauma outcomes in an evolving trauma system

Implementation of a co-managed geriatric fracture center reduces hospital stay and time–to-operation in elderly femoral neck fracture patients.

*Arch Orthop Trauma Surg.* 2013;133:1527-1531

Efficient triage
Expedited operative management
Provision of early and appropriate rehab
Smooth transition to PCC at time of discharge
Establishment of regional geriatric injury prevention programs
Multidisciplinary - care across the continuum

Perioperative Assessment and Management Guidelines

- Optimal Preoperative Assessment of the Geriatric Surgical patient: A best practice guideline from the ACS NSQIP and the AGS
- Optimal Perioperative Management of the Geriatric Patient: A best practice guideline from the ACS NSQIP and the AGS.
- Hospital Standards to promote optimal surgical care of the older adult: a report from the Coalition for Quality in Geriatric Surgery
- Developing quality indicators for the elderly surgical patients
- The impact of frailty on acute care general surgery patients: a systematic review

Despite these efforts, a standard-setting, comprehensive hospital-based program addressing infrastructure, and process and outcome elements for optimal care of the elderly surgical patient does not exist.
Clinical Assessment and preoperative optimization in the Elderly

• Avoid unnecessary and non-beneficial treatment
  • The focus is to maintain quality of life
• Optimal perioperative care improves the chances of the patient returning to their place of residence post-op
• Early resuscitation, source control, treatment of sepsis, appropriate monitoring essential!
• The Elderly:
  • Tolerate hypovolemia poorly
  • Reduced cardiovascular reserve
  • Reduced pulmonary function
  • Aspiration risk
• Underlying renal insufficiency is PREVALENT - AKI frequent risk multiplier


Range of treatment alternatives

• Risks/benefits balance between open and minimally invasive approach

• Surgery vs source control

• The first surgical procedure should focus on functional solutions with the lowest risks of complications and reoperations
  • Limit time under anesthesia time
• The need for early reoperation
  • Don’t delay
  • Is often associated with prolonged hospital stay and very poor outcomes in the elderly
Judicious use of fluids
Avoidance of medications on the BEERS list
Multimodal pain management
Early social work engagement
Expedited physical and occupational therapy
Standardized multi-tiered post discharge follow-up

J Trauma Acute Care Surg. 2018;85:167-173
Trauma And Emergency General Surgery In The Elderly: Challenges In Their Management And Important Perspectives In Care

Summary
Summary:

- The Elderly Trauma and EGS Populations are Growing!
- The Elderly Suffer Worse Outcomes Compared with Younger Adults
- More Research Is Needed to Identify Reasons for Worse Outcomes, and Interventions that Improve Outcomes

Screening and assessment of frailty - remains at the crossroads

- Several scores exist to monitor frailty in the elective settings, but none are reliable in emergency patients and trauma patients
- Several studies have demonstrated promising results for further development pending validation
  - Triage Risk Screening Tool
  - The Vulnerable Elderly Survey
  - The Charlson age- co Morbidity Index (CACI)
  - The Canadian Study of Health and Aging Frailty Index
  - Trauma Specific Frailty Index
The Structure

- Geriatric Consultation
- Geriatric Service
- Geriatric institute
- Multi-disciplinary
- Pathway driven
- Embedded geriatrician

Reciprocal/Synergistic Relationships Among 4Ms

- Provides feasible framework for implementation and measurement
- Addresses older adults’ core health issues
- Builds on strong evidence base
- Synergistic relationships → simplify and reduce burden on care team while increasing effect
- Advances priorities many of the health systems are already focused on
Your Guidebook

- Background
- Trauma Team Activation
- Initial Evaluation
- Specializing Inpatient Care
- Decision-Making Capacity
- Beers Criteria
- Substance Use/Abuse
- Depression
- Frailty
- And more
Abington Hospital Jefferson Health

Thank you!