Shades of Grey: Impact of Injury on an Aging Populace

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Disclosure / Conflict of Interest

• None
Objectives

- Epidemiology and demographics of injury and emergency surgery in the elderly
- Anatomic and physiology changes in the context of surgical disease in the elderly
- Discuss management paradigm
- Clinical decision making

Outcomes
Aging Populace

- Increased population
  - “Baby Boomer” generation
- Increased life expectancy
  - Better living conditions
    - Income
    - Nutrition
  - Preventative medicine
  - Health promotion
  - Improved diagnostics and therapeutics
Baby Boomers

- Desire for normalcy after 16 years of depression and war.
- Confidence that the future would be one of comfort and prosperity.
Population Growth
Age Demographic

US Population Growth by Age Group

% Increase (relative to 2001)

Year

<15 yo
15-44 yo
45-64 yo
65+ yo
Elderly Population Growth

Increase in the Number of Persons Aged 65+ Years in the United States

- Number (millions)
- Percent of population

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<th>Year</th>
<th>Number (millions)</th>
<th>Percent of population</th>
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<td>1920</td>
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<td>1950</td>
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<td>2010</td>
<td>47</td>
<td>(7%)</td>
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<tr>
<td>2020</td>
<td>55</td>
<td>(17%)</td>
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<tr>
<td>2030</td>
<td>72</td>
<td>(20%)</td>
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Aging in America

Figure 4: Persons 65+ as a Percentage of Total Population, 2011

(Source: 2011 Population Estimates from the U.S. Census Bureau)
Aging in America

Figure 5: Percent Increase in Population 65+, 2000 to 2011

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<th>5-9</th>
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<th>15-24</th>
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Biomechanics & Epidemiology of Injury in Elderly

- Progressive decline in central nervous system function associated with loss of proprioception, balance, and motor coordination.
- Incidence of falls and the severity of associated injury increases with advancing age.
- Medications for comorbid disease may mask physiologic signs / exacerbate injury sequelae.
- After age 44, death from cancer and heart disease overtakes injury as leading cause of death.
Major Trauma Outcome Study
Geriatric Subanalysis

• Major Trauma Outcome Study (MTOS) by ACS
• Analysis of 46,613 major trauma patients admitted to 120 Trauma Centers over 4 years
  — Geriatric subanalysis n=4,098
  — Age, mechanism of injury, outcome, length of stay, complications vitals signs, Glasgow coma score, Trauma Score, AIS
• Data used to establish age-dependent mortality rates

Major Trauma Outcome Study
Geriatric Subanalysis

- Elderly mortality double that of mortality in the younger group (27% vs. 14%).
- Markedly higher complication rate
  - Pulmonary (14/100 vs. 6.1/1100)
  - Infectious complications (4.6/100 vs. 0.7/100).
- Length of stay was twice as long for the older patients (14 days vs. 7 days).

Elderly Injury Survival

- Probability of fatal outcome increases linearly with age by 1% per year over 65
- Factors associated with poor prognosis
  - Severe head injury-GCS
  - Hypotension
  - Prolonged ventilation
  - Pneumonia
- Early cardiac dysfunction limits survival in elderly

Long Term Survival Trauma Patients

- Retrospective cohort study of 124,421 injured adult patients
- Goal: Determine the long-term mortality of patients following trauma admission
- 7243 died before hospital discharge and 21,045 died following hospital discharge
- Patients who were older and those who were discharged to a skilled nursing facility had the highest risk of death

Elderly Falls

- Most common injury - 40% elderly trauma
- 25% who fall sustain “serious injury”
- Falls M=F but females are more likely to be injured
- Anatomic / physiologic basis:
  - Decreased vision and hearing
  - Slower reflexes
  - Impaired balance and motor/cognitive function
  - Decreased bone density & muscle mass/ strength
  - Less joint flexibility
Ground Level Falls (GLF)

• Retrospective review NTDB
• 32,320 elderly GLF (>70 y/o)
• Mortality 4.4%
• GCS <15 significantly predicts mortality
• Five fold risk death from GLF than younger population

Spaniolas, J.Trauma 2010; 69:821-825
Injury Incidents
Age / Gender

NTDB (ACS COT) Report 2013
Case Fatality Rate
ISS / Age
Case Fatality
Age / Gender

CASE FATALITY RATE (%)

<1 year  3  6  9  12  15  18  21  24  27  30  33  36  39  42  45  48  51  54  57  60  63  66  69  72  75  78  81  84  87

AGE

CASE FATALITY RATE (FEMALE)  CASE FATALITY RATE (MALE)

NTDB (ACS COT) Report 2013
Injuries
Mechanism and Age
Weighted Estimates
Age / Admission Year

NTDB (ACS COT) Report 2013
Physiologic Reserve

• Definition:
  – The Individual's Ability To Tolerate Injury

• Function of factors:
  – Age
  – Gender
  – Preexisting disease
  – Immunocompetence
Outcome
Physiologic Reserve & Injury Severity

Physiologic Reserve

High ISS

Moderate ISS

Physiologic Exhaustion / Death

Time
Occult Shock in Elderly Trauma Patient

• Several studies suggest that geriatric patients may suffer from “occult hypoperfusion”
• Normal vital signs give inadequate assessment of tissue perfusion
• Identifying these patients using modalities other than physical examination and vital signs critical for optimizing their resuscitation

Diagnosing Shock in Elderly Trauma Patient

- Lactate and base deficit have been identified as one risk stratification tool


Neville: Mortality risk stratification in elderly trauma patients based on initial arterial lactate and base deficit levels. *The American Surgeon*, 77(10), 1337–1341.
SBP vs Mortality
All Patients (n=870,634)

Age vs Mortality

Systolic Blood Pressure in the ED

% Mortality

Age vs Mortality

Stratified by Young /Old

Risk of Undertriage in Geriatric Trauma

- Chang et al. 2008: 10 year retrospective review in Maryland
  - 25,565 patients
- Risk of under-triage in age group ≥ 65 was significantly greater than younger group (independent risk factor)
  - 49.9% vs. 17.8%

Geriatric ATLS

AMPLE history
A - Airway with C-spine protection
B - Breathing
C - Circulation with hemorrhage control
D - Disability
E - Exposure / Environment
AMPLE History

Allergies

Medications (particularly those with effect on hemodynamics or coagulation)
- Anticoagulants
- Antiplatelets
- Beta blockers
- Antihypertensives

Past medical history
- Cardiac disease
- Neurologic disease
- Prior surgery
- Pacemaker / defibrillator

Last meal
- High risk complications of aspiration

Events (non-traumatic events that may have precipitated injury)
- Acute coronary syndrome
- Hypovolemia
- Sepsis / pneumonia
- Stroke
- Syncope / episode
Airway

- Inspect oral cavity
  - Poorly fitting, loose dental appliances
- Airway protection
  - Shock
  - Chest trauma
  - Mental status changes
- Pitfalls
  - Loss of kyphotic curve, spondylolysis, arthritis
  - Spinal canal stenosis, decrease cervical spine mobility
- RSI—elderly
  - Increased sensitivity: opioids, benzos, sedatives
Breathing

• Aging effects on pulmonary function
  • Osteoporosis
    • Decreased rib durability
    • Increased incidence rib/sternal fxs
    • Pulmonary contusion even from low energy trauma
  • Weakened respiratory muscles/degenerative changes
    • Decrease chest wall compliance
    • Decrease pulmonary function - VC, FRC, I and E force
    • Limited ability to compensate
  • Blunted responses to hypoxia and hypercarbia and acidosis
    • Delay onset clinically apparent signs impending distress

• Adjunct
  • ABG/lactate
Chest Wall Injury

- Very common injury in elderly due to brittle rib cage
- Compared to younger patients
  - Same chest AIS
  - Increased mortality, ICU days, LOS, vent days
  - Mortality increased at 5 ribs fxs. (35% vs 10%)
  - Mortality decreased with epidural use.

J. Trauma 2000: 48(6) p 1040
Rib Fractures in the Elderly

- Retrospective review of 277 with rib fractures patients admitted to Level 1 Trauma Center
  - Study population
    - Age > 64
    - Matched Controls
      - Age 18 – 64
  - Severity of Injury
    - Mean chest AIS: 3.0 vs. 3.0
    - Mean ISS: 20.7 vs. 21.4
    - Mean Rib fx: 3.6 vs. 4.0

Rib Fractures in the Elderly

- Ventilator days:
  - 4.3 vs. 3.1
- ICU LOS:
  - 6.1 vs. 4.0
- Hospital LOS
  - 15.4 vs. 10.7

- Mortality:
  - 22% vs. 16% ($p < 0.01$).
- Each additional rib fracture:
  - Increases Mortality 19%
- Risk of pneumonia 27%


J Trauma. 2000; 48: 1040-1047
Circulation/Resuscitation

• “Normal” BP - occult shock
• Judicious fluids, blood and blood products
• Adjunct:
  – ABG/lactate/base deficit
  • Serial evaluation in triage and resuscitation
    Base deficit marker of severe injury / mortality
      – Base deficit -5 mEq/L or higher → less than 23% mortality
      – Base deficit -6 mEq/L or worse → 60% mortality
Disability

- GCS
  - TBI
  - Precipitating neurologic event
    - Highly correlated with outcome
- Lateralizing signs
  - Incidence spine / spinal cord injury
Traumatic Brain Injury (TBI)

- Brain injury risk factors
  - Cerebral atrophy / concomitant increase intracranial space
  - Delayed presentation extra axial hemorrhage
  - More susceptible traumatic tears bridging veins (subdural hematoma)
- >65 y/o 2-5x mortality of younger groups with matched GCS/intra-cranial pathology
- Early diagnosis and management central to improve outcomes
Management Coagulopathy

- Elderly patients who were taking medications for systemic anticoagulation before their injury
- Assessment of their coagulation profile as soon as possible after admission
- Expeditious head CT
Coagulopathy Management

- Coagulopathy after injury in the elderly population is associated with worse outcomes than similar injury in other age strata.

- Patients receiving warfarin with a posttraumatic intracranial hemorrhage should receive therapy to correct their international normalized ratio (INR) within 2 hours of admission.
Coagulopathy Management

- TEG / platelet mapping assay
- Specific therapy
  - Warfarin (factor repletion)
    - FFP
    - Profilnine (Factor II, VII, IX, X)
  - Anti-platelet (most not reversible)
    - Transfuse platelets
    - Serial assessment residual platelet activity
Geriatric Brain Injury Outcomes

- Highly correlated with recovery from brain injury
  - Elderly patients with severe traumatic brain injury (GCS ≤ 8)
  - At least 80% mortality or long term placement disposition
  - Justifies discussion regarding goals of care after resuscitation

- Futility
- Advance directives

Exposure

- Elderly trauma risks for hypothermia and pressure ulceration
- Poor nutrition / loss of lean muscle mass
- Microvascular changes
- Blunted hypothalamic function
- Rectal temperature and rewarming methods
- Reduce incidence of hypothermia associated coagulopathy
- Off back board, clear cervical collar, spine ASAP
Dedicated Geriatric Care
G-60 Model

- Dedicated intensive geriatric injury care management programs compared to standard trauma programs
  - Decreased mortality
  - Decreased ICU length of stay and decreased hospital length of stay
  - Decreased time to OR
  - Diminished rate of pulmonary complications

Mangram., J Trauma 2012;72:119-122
Geriatric Consultation

- Geriatric consultation
- Comprehensive Geriatric Assessment (CGA)
- Multi-disciplinary diagnostic instrument
- Data on medical, psychological, functional capabilities and limitation in geriatric patients
- Develops treatment and follow-up plans
- 22 randomized trials / > 10,000 patients
- Outcomes
  - Increased survival and likelihood to be home at 1 year
  - Fewer episodes of delirium
  - Decrease in-patient falls
  - Decreased length of stay
  - Decreased complication
EAST CPG
Management Injury in Elderly

- Elderly trauma patients should be treated at centers that have appropriate resources
- TBI with warfarin-induced coagulopathy, the coagulation profile should be immediately assessed and corrected as necessary
- Base deficit > 5mEq/L should be used as a marker for severe injury and admission to ICU
- GCS ≤ 8, persistent after 72 hrs warrants discussion regarding goals / endpoints of care
Factors Predictive Post-Hospitalization Functional Decline and Poor Quality of Life

Pre-Operative
- Age ≥ 70 years
- Comorbid conditions
  - Diabetes, CHF, neoplasia
  - Functional Impairment in > 2 ADLs
  - Cognitive impairment (dementia)
  - Low level social activity (mobility or depression)

Post-Operative
- Poorly controlled pain
- Delirium

Conclusion

- Rapid assessment / clinical and radiographic (Head CT especially important)
- Correction of coagulopathy with extraaxial lesion and anticoagulants
- GCS ≤ 8 associated with poor outcome
  - Realistic expectation outcomes
  - Communication with families
- Multidisciplinary team and treatment plan to reduce complications and improve outcome
Conclusion

• Elderly population (≥65) majority of trauma admissions over the next three decades

• Elderly trauma patients
  – Anatomic/physiologic differences
  – Limited physiologic reserve

• High index suspicion
  – Occult shock

• Base deficit assessment

• Low threshold ICU admission

• Consider triage to designated trauma centers