Geriatric Trauma: Evolving Concepts in a Rapidly Growing Population

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Disclosures

- None
How old are you?

1. 20-35
2. 35-50
3. 50-65
4. >65
Geriatric Trauma: An emerging public health issue

- Geriatric population – Age 65 and older
- Elderly currently 1/10th general population
- Account for 1/3rd trauma expenditures
  - 9 billion dollars for geriatric trauma per year in the U.S.

- Census Bureau
  - 65 and older age group nearly double over next 20 years
  - 46 million - 2010
  - 81 million - 2030
Physiologic Reserve

- Defined As:
  - The Individual's Ability To Tolerate Injury

- Function Of Unique Host Factors:
  - Age
  - Gender
  - Preexisting Disease
  - Immuno-competence
Physiologic Reserve
Injury Severity Determines Slope

Physiologic Reserve
Physiologic Exhaustion
Death

High ISS
Moderate ISS

Time
Host Factors Define Physiologic Reserve

- Young & Healthy
- Age
- Underlying Disease

Physiologic Reserve vs. Host Factors
Age and Compensatory Responses to Trauma

- Decreased vision and hearing
- Slower reflexes
- Poorer balance
- Impaired motor/cognitive function
- Decreased muscle mass/ strength
- Decreased bone density
- Less joint flexibility
Co-morbidities

- ~80% GT patients have 1 or greater chronic diseases - Most Common
  - HTN
  - Arthritis
  - Heart disease
  - Pulmonary disease
  - Cancer
  - Diabetes
  - Stroke
Co-morbidities

- Often initiating event for trauma
- Diminished pre-injury functional status leading predictor of poor outcome
- Substantially increases incidence complications
- Probability of mortality increases as number of co-morbidities increase
Complications

- GT in-patient complication rate 33%
- Contribute to increase LOS, functional outcome and cost
  - Cardio-vascular compromise
  - Pneumonia
  - Delirium
  - Multi-organ failure
- Preventable complication contribute to over 30% of all GT deaths
- Rest complications related to pre-existing conditions and age-related physiologic changes
Specialized Geriatric Inpatient Care

- Proactive geriatric consultation
- Comprehensive Geriatric Assessment (CGA)
- Multi-dimensional, multi-disciplinary diagnostic instrument
- Data on medical, psychological, functional capabilities and limitation in GT patients
- Helps develop treatment and follow-up plans
- 22 randomized trials/ > 10,000 patients

CGA

- Increased survival and likelihood to be home at 1 year
- Fewer episodes of delirium
- Decrease in-patient falls
- Decreased length of stay
- Decreased complication

ACS TQIP Geriatric Management Guidelines
Geriatric Trauma Service: A one year experience

- G-60 Geriatric Trauma Unit in Level II
- Worked on collaboration
  - Medical hospitalist
  - Physiatrist
  - PT/OT/RT
  - Nursing supervisor with geriatric experience
  - Palliative care specialist
- Compared before/after G-60- 280pts/393pts
- Decreased time to OR
- Decreased ICU and hospital LOS
- Decreased complications
- Decreased mortality rate

Mangram et al, J.Trauma 2012;72:119-122
What is the most common MOI leading to DEATH in the geriatric trauma population?

1. Falls
2. MVC
3. Auto-Ped
4. Assault/violence
5. Suicide
Motor Vehicle Collisions
Motor Vehicle Collisions

- Second most common cause of injury in GT
- Most common cause of mortality
- Majority are drivers
- Debate on restrictions
- How safe are senior drivers?
http://youtu.be/aoXr1T0CzjE
A RISK BEHIND THE WHEEL?

VANDERBILT SURGERY
When to take the keys away?

- Aging does NOT automatically equal loss of driving ability
- Eyes checked annually
- Hearing checked annually
- Talk to PCP - effects co-morbidities/medications
- Defensive driving education
- Know limitations
- Listen to concerns of others
- Get a professional evaluation
- Anonymous report to state DMV
- Florida - Eye exam >80
- Montana - Renew q 3 yrs >70 with eye exam only
- Mandatory physical and eye test at 75/80, q 2 yrs in Quebec
- Written test at 80 in Ontario
Falls

- Most common mechanism of injury in elderly
- 5-10x more EMS calls r/t falls than MVCs
- 30% >65 y/o fall each year, 50% > 80 y/o
- 10% result in serious injury - fracture/CHI
- 10-30% multi-trauma
- Leading cause non-fatal injuries in GT
- 7% mortality
Ground Levels Falls

- Emerging as #1 cause for admission to trauma centers
Ground Level Falls (GLF)

- Retrospective review NTDB
- 32,320 elderly GLF (>70 y/o)
- Mortality 4.4%
- More likely to sustain
  - Long bone fxs, pelvic fxs and CHI
- GCS <15 significantly predicts mortality
- 5x > chance dying from GLF than younger population

Spaniolas, J.Trauma 2010; 69:821-825
The Course of Disability before and after a Serious Fall Injury

- Prospective cohort over 14 yrs in 754 community-living persons age >70
- Initially nondisabled in basic ADL
- 130 participants sustained serious fall
- Probabilities of post-fall trajectory greatly influenced by pre-fall trajectory
- Substantive recovery highly unlikely among those with progressive or severe disability

Gill et al, JAMA 2013, 173: 1780-1786
The Course of Disability before and after a Serious Fall Injury

- ½ lived alone before fall
- Average age 86, 73% female
- 67% physically frail
- Rapid recovery observed ONLY for those who has no disability or mild disability before fall
- Only 1/3 with moderate disability recovered
- Without exception, NO recovery in those with severe disability before fall

Gill et al, JAMA 2013, 173: 1780-1786
Evaluation and management of geriatric trauma: An Eastern Association for the Surgery of Trauma practice management guideline

Calland et al, J Trauma Acute Care Surg 2012, 73:S345-S350
How do Geriatric trauma patients behave differently?

- “Normal” presenting vital signs are unreliable in the geriatric trauma patient
  - Heart rate > 90 or a systolic blood pressure < 110 mmHg suggests under-resuscitation
  - “110 is the new 90” National Trauma Triage Protocol for age >65

- “Occult hypoperfusion”

- Identifying these patients using modalities other than physical examination and vital signs critical for optimizing their resuscitation
Primary Survey

- Adult (young or old) / pediatric / pregnant - priorities are the same!

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

Inspect oral cavity
   Poorly fitting, loose dental appliances
   Bag-valve mask difficult with edentulous airway

When in doubt- INTUBATE, especially with
   Shock
   Chest trauma
   Mental status changes

RSI- medication doses adjusted in elderly
   Age-related decline renal clearance/ hepatic function
   Increase sensitivity opioids, benzos, sedatives
   All can drop BP
   Etomidate can cause adrenal insufficiency
Breathing

- Aging - myriad of effects on pulmonary function
- Osteoporosis
  - Decreased rib durability
  - Increased incidence rib/sternal fractures
  - Pulmonary contusion even from low energy trauma
- Weakened respiratory muscles/degenerative changes
  - Decrease chest wall compliance
  - Decrease pulmonary function
  - Limited ability to compensate
- Blunted responses to hypoxia and hypercarbia and acidosis
- Delay onset: signs of respiratory distress
- Early ABG/lactate
What’s wrong with this picture?
Bad sign
Circulation/Resuscitation

- **Judicious** fluids, blood and blood products
- Early angiographic embolization increasing role in non-op management GT
  - Complex pelvic fractures
  - Splenic, liver, kidney lacerations
Angiographic Embolization
Pelvic Fractures

- Most common after fall
- Lateral compression fractures
  - > 50% multiple fractures
  - Hip with wrist/shoulder fractures
- Higher rates hemorrhage
  - Binder/sheet
  - Transfusion
  - Angio-embolization
  - ICU admission
Pelvic Wrap-Sheet and towel clips
Commercially available Pelvic Binders
Disability/Exposure

- Elderly trauma risks for hypothermia and pressure sores
  - Poor nutrition
  - Loss of lean muscle mass
  - Microvascular changes
  - Blunted hypothalamic function
- Rectal temperature and rewarming methods
- Reduce incidence of hypothermic-induced coagulopathy
- Off back board, clear cervical collar, spine ASAP
Traumatic Brain Injury (TBI)

- Early diagnosis and treatment critical to improve outcome
- >65 y/o 2-5x mortality of younger groups with matched GCS/intra-cranial pathology
- Overall mortality TBI with ICH- 30-85%
- Brain weight decreases by 10% btw 30-70 y/o
  - Cerebral atrophy
  - Increase intracranial space
  - Mask ongoing bleed, subtle presentations, delay dx
  - More susceptible traumatic tears, subdural hematoma
TBI and Anticoagulants

- Dramatically increase morbidity and mortality associated with elderly TBI
- Coumadin
  - Independent predictor mortality TBI
  - 3-10 fold increase mortality in GT
  - Elderly more likely present with supra-therapeutic INR
- Early protocol-driven reversal key to improving outcome

- No good reversal strategies for anti-platelet agents (ASA, clopidogrel/plavix)
  - Platelet transfusion, desmopressin(DDAVP) and rFVIIa MAY offset some bleeding
Early Protocol-Driven Reversal Key to improving outcome

- All patients on anticoagulation - coagulation profile on admission to ED
- Suspected head injury - Immediate CT scan
- Patients on warfarin with intra-cranial bleed
  - Correction of INR to < 1.6 within 2 hrs
  - FFP and Vitamin K
  - 75% decrease in mortality
**TBI and Direct Factor Inhibitors**

Dabigatran (Pradaxa) - direct thrombin inhibitor

Rivaroxaban (Xarelto) - direct Xa inhibitor

High risk bleeding even with minor injury

**NO MEANS OF REVERSAL**

Investigational studies –

- Dialysis and Prothrombin Complex Concentrate (PCC), antibody fragments (Fab)

Several case reports of mortality from GLFs and TBI in elderly patients with A.fib

Thromboelastogram (TEG) useful to ID presence of these drugs and platelet inhibitors
Geriatric Patients and Traumatic 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 initial phase of care and withdrawal of all sedatives

Case Presentation

- 69 y/o farmer, tractor rollover accident
- Small SDH, C5Fx, multiple rib fxs, G2 spleen
- H/O A.fib (ASA), HTN
- ATV accident one year prior - did well
- Epidural placed
- Agitation, delirium improved over several days
- Day 6 walking in halls - A.fib/RVR/SVT - BB
- Day 7 Agitation, altered mental status, respiratory distress, intubated
- Head CT - left cerebellar infarct, scattered embolic infarcts.
Palliative Care Service

- Improved communication about goals of care in relation to prognosis and patient preference
- Invaluable assistance in arriving at appropriate treatment decision
- Facilitates discussions, reverses communication breakdowns
- Fresh perspective to case, not same emotional investment
- Assist in EOL issues, grief counselling, transitional planning, family and spiritual support
COMMUNICATION

Han Solo learned to understand Wookie. He didn’t complain that Chewbacca didn’t speak English.
Case presentation- 70 y/o farmer- Cerebellar infarct

Trach/PEG/LTAC

Comfort measures
Withdraw of support
Geriatric Trauma: Cognitive Decline and Physical Frailty Predict 6-Month and 1-Year Outcomes

CA Maxwell, MS Dietrich, LC Mion, K Mukherjee, A Minnick, A May, RS Miller
Methods

- Prospective longitudinal cohort study
- Sample: 188 patients (age 65 and older) admitted through the ED with a primary injury diagnosis
- Follow-up: 30-days, 90-days, 6-months, 1-year


Proposed relationships and study aims.

1. Pre-injury Cognition
   Physical function

2. Post-injury Cognition
   Physical function
   (@ admission, discharge, 30-day, 90-day, 180-day)

3. Venous Lactate

4. Mobilization

Outcomes
- In-patient
  - Mortality - LOS - DC
  - Disposition

- Post-hospitalization
  - (30, 90, 180-day)
  - readmissions - 30, 90, 180-day mortality

Contributing Covariates
- Age
- Gender
- Race/Ethnicity
- Social characteristics
- Injury severity
- Injury type
- Comorbidities
Procedures

- Surrogate respondents interviewed within 48 hours of admission
- Validated brief screening instruments:
  - Vulnerable Elders Survey (VES-13): **FRAILTY** (13 items)
  - Barthel Index (BI): **DISABILITY** (10 items)
  - Life Space Assessment (LSA): **MOBILITY** (15 items)
  - AD8 Dementia Screen (AD8): **MEMORY & THINKING** (8 items)
Preliminary Data during study-
N=134

- 42% male/58% female, mean age 76 (65-101)
- Mechanism of Injury:
  - Fall from standing- 53%
  - Fall from other- 11%
  - MVC, driver- 20%
  - MVC, pass.- 3%
  - Pedestrian- 2%
  - GSW- 2%
  - Other- 10%
- Living arrangements:
  - Lives alone: 23%
  - Lives with spouse: 50%
  - Lives with others: 27%
- Living location:
  - House/apt: 92%
  - Assisted living: 4%
  - SNF: 4%
### Patient Characteristics of Sample (N=188)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ALL patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Med, IQR)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Gender (N, %)</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>106 (56%)</td>
</tr>
<tr>
<td><strong>Mechanism of injury (N, %)</strong></td>
<td>101 (54%)</td>
</tr>
<tr>
<td>Fall from standing</td>
<td>25 (13%)</td>
</tr>
<tr>
<td>Fall from other</td>
<td>37 (20%)</td>
</tr>
<tr>
<td>MVC-driver</td>
<td>10 (5%)</td>
</tr>
<tr>
<td>MVC-passenger</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>12 (6%)</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td><strong>Hospital disposition (N, %)</strong></td>
<td>53 (28%)</td>
</tr>
<tr>
<td>Home</td>
<td></td>
</tr>
<tr>
<td>Facility other than home</td>
<td>116 (62%)</td>
</tr>
<tr>
<td>Expired (inpatient)</td>
<td>18 (10%)</td>
</tr>
<tr>
<td><strong>Mortality (6-months)</strong></td>
<td>34 (18%)</td>
</tr>
<tr>
<td><strong>Mortality (1-year)</strong></td>
<td>47 (25%)</td>
</tr>
<tr>
<td><strong>Comorbidity Index (Med, IQR)</strong></td>
<td>3 (0-9)</td>
</tr>
<tr>
<td><strong>Injury Severity (Med, IQR)</strong></td>
<td>10 (9-17)</td>
</tr>
</tbody>
</table>
Data

- 30-37% Cognitive impairment consistent with dementia
- 56% Functional impairment consistent with frailty
- Q- At least once a week, do you engage in regular activity akin to brisk walking, jogging, bicycling, swimming, etc, long enough to work up a sweat, get your heart thumping or get out of breath?
  - Yes- 30%
  - No- 70%
Conclusion

- Few survivors after injury return to their baseline functional status by one year post-hospitalization.
- Pre-injury disability is the primary predictor of functional status at 6-month and 1-year.
- Cognitive impairment predicts functional status at 6-months.
- 1 in 4 (25%) patients die within one year.
- Age, injury severity, and pre-injury disability predict mortality within one year.
- Pre-injury physical frailty, as a measure of disability is the predominant predictor of mortality.
Limitations

- Relatively small sample size
- Single site

Next Steps

- Bedside frailty screening as a trigger for early geriatric palliative care
Summary

- Elderly population (≥65) fastest growing age group
- Will account for majority of trauma admissions over the next 20 years
- Falls most common mechanism for admission—not benign
- GT patients behave differently
- Limited physiologic reserve
- Do not rely on “normal” vital signs
- Pulse > 90, SBP< 110 risk of occult hypo-perfusion
- Measure ABG/base deficit/lactate
Summary

- Low threshold for CT scan
- Rapid Head CT and correction of coagulopathy with ICH and anticoagulants
- GCS $\leq 8$, which remains low after 72hrs warrants discussion regarding goals of care
- Create multi-disciplinary team and treatment plan to reduce complications and improve outcome
- Pre-injury frailty predicts outcome