Geriatric Trauma: Evolving Concepts in a Rapidly Growing Population

Richard S. Miller, MD FACS
Professor of Surgery
Chief, Division of Trauma, Surgical Critical Care and Emergency Surgery
Vanderbilt University Medical Center

ACNP Boot Camp
Vanderbilt University Medical Center
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Disclosures

- None
Geriatric Trauma:
An emerging public health issue

- Geriatric population – Age 65 and older
- Elderly currently $1/10^{th}$ general population
- Account for $1/3^{rd}$ 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- Baby Boomers, Living Longer
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 Exhaustion

Time

Death
Host Factors Define Physiologic Reserve

- Young & Healthy
- Age
- Underlying Disease

Physiologic Reserve

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
http://youtu.be/dAOYihfL9CA
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-hospital complication rate 33%
- Contribute to increase LOS and cost, worse outcome
  - 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
What is the most common complication in critically injured GT patients?

1. Dysrhythmias
2. Pneumonia
3. Delirium
4. Multi-organ failure
Delirium

- Very common in elderly after injury
- Associated with increase morbidity and mortality
- Monitor daily - CAM-ICU & RASS tools
- Risk Factors Prior to Injury
  - Cognitive impairment and dementia
  - Depression
  - Alcohol use
  - Poly-pharmacy and psychotropic meds
  - Poor nutrition
  - Hearing and vision impairment
Delirium

- Acute onset & fluctuating course
- Inattention
- Disorganized thinking
- Altered LOC

AND

PLUS either or both

DELIRIUM
## Step 1: Level of Consciousness Assessment

<table>
<thead>
<tr>
<th>Scale</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>COMBATIVE</td>
<td>Combative, violent, immediate danger to staff</td>
</tr>
<tr>
<td>+3</td>
<td>VERY AGITATED</td>
<td>Pulls to remove tubes or catheters; aggressive</td>
</tr>
<tr>
<td>+2</td>
<td>AGITATED</td>
<td>Frequent non-purposeful movement, fights ventilator</td>
</tr>
<tr>
<td>+1</td>
<td>RESTLESS</td>
<td>Anxious, apprehensive, movements not aggressive</td>
</tr>
<tr>
<td>0</td>
<td>ALERT &amp; CALM</td>
<td>Spontaneously pays attention to caregiver</td>
</tr>
<tr>
<td>-1</td>
<td>DROWSY</td>
<td>Not fully alert, but has sustained awakening to voice (eye opening &amp; contact &gt;10 sec)</td>
</tr>
<tr>
<td>-2</td>
<td>LIGHT SEDATION</td>
<td>Briefly awakens to voice (eyes open &amp; contact &lt;10 sec)</td>
</tr>
<tr>
<td>-3</td>
<td>MODERATE SEDATION</td>
<td>Movement or eye opening to voice (no eye contact)</td>
</tr>
</tbody>
</table>

If RASS is ≥ -3 proceed to CAM-ICU (Is patient CAM-ICU positive or negative?)

-4        DEEP SEDATION No response to voice, but movement or eye opening to physical stimulation
-5        UNAROUSABLE No response to voice or physical stimulation

If RASS is -4 or -5 → STOP (patient unconscious). RECHECK later
Confusion Assessment Method for the ICU (CAM-ICU) Flowsheet

Delirium can only be assessed in patients more alert than RASS -3 or SAS 3

1. Acute Change or Fluctuating Course of Mental Status:
   - Is there an acute change from mental status baseline?  OR
   - Has the patient’s mental status fluctuated during the past 24 hours?
   - No
     - CAM-ICU negative NO DELIRIUM
   - Yes
     - 0 - 2 Errors
       - CAM-ICU negative NO DELIRIUM
     - > 2 Errors
       - RASS other than 0 or SAS other than 4
         - CAM-ICU Positive DELIRIUM Present

2. Inattention:
   - “Squeeze my hand when I say the letter ‘A’.”
   - Read the following sequence of letters: S A V E A H A A R T
   - ERRORS: No squeeze with ‘A’ & Squeeze on letter other than ‘A’
   - If unable to complete Letters → Pictures
   - No
     - CAM-ICU negative NO DELIRIUM
   - Yes
     - RASS = 0 or SAS = 4
       - > 1 Error
         - CAM-ICU negative NO DELIRIUM
       - 0 - 1 Error
         - CAM-ICU negative NO DELIRIUM

3. Altered Level of Consciousness
   - Current RASS or SAS level

4. Disorganized Thinking:
   1. Will a stone float on water?
   2. Are there fish in the sea?
   3. Does one pound weigh more than two?
   4. Can you use a hammer to pound a nail?
   Command: “Hold up this many fingers” (Hold up 2 fingers)
   “Now do the same thing with the other hand” (Do not demonstrate)
   OR “Add one more finger” (If patient unable to move both arms)

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Source: Crit Care Med © 2013 Lippincott Williams & Wilkins
Delirium

- Reversible Causes
  - Wake-sleep cycle disturbances and sleep deprivation
  - Immobilization
  - Hypoxia
  - Infection
  - Uncontrolled pain
  - Renal insufficiency, dehydration, electrolyte abnormalities and urinary catheter
  - Fecal impaction and constipation
  - Use of restraints
Multi-disciplinary Treatment Plan

- Early mobilization/ambulation - within 24-48 hours
- Aspiration precautions
  - Elevate HOB at all time with repositioning
  - Sit upright while eating and 2 hrs after
  - Evaluate for swallowing deficits
- Chest PT- IS/deep breathing exercises
- Early enteral nutrition
- Pain control
- Bowel regimen, especially with opiate use
- Pressure ulcer screening - Braden scale within 24hrs
- Assessment of cognition/sleep disturbances
Specialized Geriatric Inpatient Care

- Comprehensive Geriatric Assessment (CGA)
- Multi-dimensional, multi-disciplinary
- 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 complications
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
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
Rib Fractures in the Elderly

- Extensive literature describing increased morbidity and mortality with Chest Injury in GT
- 277 patients over 65 with rib fractures
- For EACH rib fx- increases risk pneumonia by 27% and mortality by 19%
- Pain management essential to reduce complications and death
  - PCA
  - Epidural
  - Comprehensive pain service

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 injury by CT
- 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 reversal with FFP and Vit.K = key to improving outcome
- No good reversal strategies for anti-platelet agents (ASA, Clopidogrel/Plavix) or thrombin-inhibitors (Pradaxa, Xarelto)
  - Platelet transfusion, desmopressin (DDAVP), Factor 7a, and PCC MAY offset some bleeding
What’s wrong with this patient?
Skin Assessment

- Elderly trauma risks: hypothermia & pressure sores
  - Poor nutrition
  - Loss of lean muscle mass
  - Microvascular changes

- Rectal temperature and rewarming methods

- Reduce incidence of hypothermic-induced coagulopathy

- Off back board, clear cervical collar, spine ASAP
EVERY PRESSURE ULCER IS PREVENTABLE!!
Level One Transfuser
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
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
Leading causes of death according to CDC
Falls

- Now leading cause of injury and fatality in GT
- 7% mortality
- 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
Ground Levels Falls (GLF)

- #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 fx, pelvic fx and CHI
- GCS <15 significantly predicts mortality
- 5x > chance dying from GLF than younger population

Spaniolas, J.Trauma 2010; 69:821-825
Pelvic Fractures

- Most common after fall
  - > 50% multiple fractures
- Higher rates hemorrhage
  - Binder/sheet
  - Transfusion
  - Angio-embolization
  - ICU admission
Angiographic Embolization
Pelvic Wrap:
Sheet and towel clips
Commercially available Pelvic Binders
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
Preinjury Physical Frailty and Cognitive Impairment among Geriatric Trauma Patients determines Post-injury Functional Recovery and Survival

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

J Trauma Acute Care Surg. 2016;80:195-203
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


Procedures

- Family members 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)
Physical Frailty

- A medical syndrome with multiple etiologies, characterized by diminished strength, endurance and reduced physiologic function \(^1\)

- A clinical marker of physiologic age \(^2,^3\)

\(^1\)Morley et al. (2013); \(^2\)Ingles et al. (2014); \(^3\)Vidal et al. (2015)
Frailty

Free Radicals/Antioxidants

**ANTIOXIDANT**

Donates electron to stabilize harmful oxygen species

**OXYGEN FREE RADICAL**

Unstable oxygen species, has unpaired electron

**HOW ANTIOXIDANTS WORK AGAINST OXYGEN FREE RADICALS**

Sarcopenia/
Loss of Gray Matter Volume

The Cerebellum – White and Gray Matter

- White matter of cerebellum (Arbor vitae)
- Brain stem (midbrain)
- Cerebellar cortex
- Caudal (inferior)
- Vermis (cut)
- Deep cerebellar nuclei

(d) Coronal section, posterior view
Pre-frailty

- An intermediate stage in the frailty trajectory
- **Sub-aim**: to prevent those in the ‘pre-frail’ category from becoming frail after their injury
- Determine risk factors and make lifestyle modifications to slow down the process of becoming frail

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Pre-Injury Living Situation
188 patients

- **Living arrangements:**
  - Lives alone: 23%
  - Lives with spouse: 50%
  - Lives with others: 27%

- **Living location:**
  - House/apt: 92%
  - Assisted living: 4%
  - SNF: 4%
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ALL patients</th>
</tr>
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<tbody>
<tr>
<td><strong>Age (Med, IQR)</strong></td>
<td>77 (69-86)</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></td>
</tr>
<tr>
<td>Fall from standing</td>
<td>101 (54%)</td>
</tr>
<tr>
<td>Fall from other</td>
<td>25 (13%)</td>
</tr>
<tr>
<td>MVC-driver</td>
<td>37 (20%)</td>
</tr>
<tr>
<td>MVC-passenger</td>
<td>10 (5%)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Other</td>
<td>12 (6%)</td>
</tr>
<tr>
<td><strong>Hospital disposition (N, %)</strong></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>53 (28%)</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%
VES-13 TRAJECTORIES OF SURVIVORS (N=129):
FRAILTY

N=16
N=52
N=61
N=53
N=52
N=24

VES-13 Index Group:
- No Frailty (0)
- Pre-Frailty (1-3)
- Frailty (4-10)
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.
- Pre-injury physical frailty, as a measure of disability is the predominant predictor of poor outcome and mortality.
Limitations

- Relatively small sample size
- Single site

Next Steps

- Enlarge study
- Implement bedside frailty screening tool as a trigger for early geriatric palliative care
- Educate families
74 y/o female falls down two steps. Prior to her injury she could walk around the block and only fatigues climbing a flight of stairs. She has 5 illnesses but her weight has been stable. Is this patient:

1) Non-frail
2) Pre-Frail
3) Frail
4) Non of the above
The Simple “FRAIL” Questionnaire Screening Tool

- 3 or greater = frailty, 1 or 2 pre-frail

- 1. **Fatigue**: Does the patient fatigue easily?
- 2. **Resistance**: Can the patient walk up one flight of stairs?
- 3. **Ambulation**: Can the patient walk 1 block (or ¼ mile)?
- 4. **Illnesses**: Does the patient have multiple illnesses?
- 5. **Loss of weight**: Has the patient lost more than 5% of his/her weight in past 6 months to a year?
COMMUNICATION

Han Solo learned to understand Wookie.
He didn’t complain that Chewbacca didn’t speak English.
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
Vanderbilt Palliative Care Service
Palliative Care Service

- Bring in proactively rather than reactively
- Promotes open dialogue and discussion btw medical team and family
- Shows family you are open to discussion and different view points
- All working toward achieving best outcome for patient
- Versus more divisive and adversarial debate over whether a therapy is futile
- Encourages collaboration and SHARED DECISION MAKING
What is shared decision making?
What is shared decision making?

Figure 1. Conceptual Model

- Family Network
  - Shared History & Patient Knowledge
- Joint Social Network
  - Shared Agency
- Patient Care Path
  - Preparedness for Care Transitions
- ICU Care Team Network
  - Critical Decisions & Ongoing Care Transitions
“Patients and providers have different — but equally valuable — perspectives and roles in the medical encounter”

— Gregory Makoul
Case Presentation

- 69 y/o farmer, tractor trailer
- Head injury, splenic laceration, multiple rib fx s
- H/O A.fib, CAD, HTN
- ATV accident one year ago
- Epidural catheter for pain
- Agitation, delirium improved over several days
- Day 6- RVR/SVT- BB
- Day 7- agitation, hypoxia, AMS, respiratory distress, intubation
- Head CT- left cerebellar infarct, scattered embolic infarcts
Case presentation - 70 y/o farmer
Cerebellar infarct

Trach/PEG/LTAC

Comfort measures
Withdraw of support
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
- Measure ABG/base deficit/lactate
Summary

- Rapid Head CT and correction of coagulopathy with ICH and anticoagulants
- GCS ≤ 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
- Education, communication and shared decision making essential in this patient population