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Injury: An Age-Old Problem

As a country, we're not only getting better---we're getting older. The fastest growing segment of our population is the slowest to heal after injury. This course highlights major and minor injuries in the elderly, as well as out-of-hospital concerns, patient identification, and injury prevention.

- List three common injuries in the elderly.
- Describe two common injury complications in the elderly.
- Describe prevention measures for elder trauma.

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FACULTY

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Injury: An Age-Old Problem

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INTRODUCTION

- The elderly account for 10% of all trauma victims
- Longer hospital stays
- Higher mortality rates
- Mortality rates are nearly double those of younger patients with identical ISS scores
- Higher complication rates (pulmonary and infectious)

Changing demographics

- Aging of the population:
    - 4% in 1900
    - 12% in 1984
    - 14% in 1990
    - Predictions: 25% by 2030
- 28% of injury fatalities in 1984
- Projected that the elderly will comprise 40% of the trauma population by 2050
- 1/3 of trauma care dollars are spent on the elderly

Definitions

- Elderly: Older than 65
- Young old: 65-80
- Old old: >80
    - Worse outcome when injured
- ATLS: Over 55 lower the threshold for trauma centers
- Physiological age is a better criteria than chronological age when making predictions and in determining management strategies

Differences Between Young and Elderly Trauma Patients
(Distinguishing Features of Trauma in the Elderly)

- Predisposition to injury
    - Diminished sight and hearing
    - Problems with gait and coordination
        - Impaired sensation and proprioception
        - Weakness of musculature
        - Degenerative joint disease
        - Neuromuscular disorders
        - Dementia
- Different mechanisms of injury
- More severe response to a given mechanism
    - Musculoskeletal, intracranial, and thoracoabdominal injuries are more severe given equal amounts of trauma
- Pre-existing disease and functional changes in the elderly result in a decreased ability to respond to trauma
- Other events may have triggered the trauma (syncope, MI)
- Highest trauma related mortality of any age group
- Different patterns of injury

- Occult presentations
- Worse outcome
- Death often occurs from underlying disease rather than from traumatic injury
- Inadequate reimbursement for trauma care

Distinguishing Characteristics of Trauma in the Elderly

Age:	> 65	< 65
Number:	3,833	42,944
Male/Female Ratio:	.93	3.3
Injury Severity Score:	13.3	13.4
Revised Trauma Score:	7	7
Mechanisms of Injury:	Falls	MVC
	MVC	Other
	Auto-pedestrian	GSW

Santora, 1994

The unanswered questions
- What preventive measures can be taken to decrease the incidence of geriatric trauma?
- What different diagnostic measures should be undertaken in the elderly trauma patient?
- What different therapeutic interventions should be undertaken in the elderly trauma patients?
- When does resuscitation become futile in the elderly trauma patients?

Mortality Rates
- Elderly patients are five to six times more likely to die of similar injuries than are their younger cohorts
  - Cardiovascular complications (first 24 hours)
  - Impaired pulmonary or immunologic reserves (third peak of death)
- Fatality rate after MVC for patients > 70 y.o. is three times the rate for 20 y.o. patients
- Increased in patients $\geq$ 80 y.o. (46% vs.10%)
  - ISS $\geq$ 25: 80% mortality rate (survivors required permanent nursing care) [DeMaria]
- Chronic illness may play a role
  - Ischemic heart disease, cirrhosis, COPD, DM (Morris)
- Trauma scoring systems are less useful predictors in the older patient
  - ISS underestimates risk of low score in the elderly
  - ISS with a 10% mortality rate was 17.3 for patients > 65 vs. 24.9 for younger patients (Smith, 1990)
  - This was contradicted in a recent study that reported that ISS predicted mortality
    - These were moderate to major trauma patients (Tornetta)
- Elderly trauma patients are more likely to suffer late deaths (> 24 hours) than younger patients due to preexisting illness and increased risk of complications
  - In this study, mortality was twice that in younger patients
  - Predictors of late mortality: ISS, Revised Trauma Score (RTS), preexisting cardiovascular or liver disease, development of cardiac, renal, or infectious complications (Perdue)
- Significantly greater mortality and morbidity after chest trauma
- After cervical spine injury: 26% for patients with associated spinal cord injury
- After abdominal trauma: 4.7 fold greater mortality rate than for younger patients
  - Injuries are harder to recognize
- After hip fracture: 5% mortality

Mortality Rates For Multisystem Geriatric Trauma
- Mechanism: falls (59%), MVC (36%)
- Closed head injury and fractures were the common injuries

- Factors associated with mortality: previous MI, chronic renal insufficiency, ventilatory or ionotropic support, shock, bradycardia, GCS $\leq$ 8
- 23% mortality rate
- 75% of the deaths occurred in the first 24 hours (CHI)
- At discharge, 53% went home, 36% went to a nursing home [Zietlow]

Morbidity
- 8-57% return to independent living within one year
- 33% complication rate vs. 19% for younger population (Champion)
- 40%-65% of admitted patients require nursing home placement
- Length of stay is up to 69% longer for patients with pre-existing chronic illnesses (MacKenzie)

Things That Correlate With a High Mortality Rate
- Head trauma, shock, hypoxia, sepsis, prolonged ventilatory dependence, multisystem organ failure
- (Horst, 1986)

Mortality of Head Injury
- Glasgow Coma Score of $\leq$ 8: 80% mortality rate
- Subdural hematoma
  - Mortality rates four times that of younger adults
  - 75% mortality rate (Howard)
  - 100% six month mortality for patients who are comatose after 72 hours
  - 90% mortality for patients who develop increased ICP (Ross)
- After shock, neurotrauma is the second most important predictor of fatal outcome
- Poor chance of cognitive recovery in patients who are in coma > 5.5 days
  - Very different from young adults
- Patients > 80 y.o.: even higher mortality
  - 88% for SDH in 26 patients vs. 57% in 215 patients < 80 y.o. (Cagetti)

Implications
- Implications of the health care crisis
  - Outcome studies and financial pressures may indicate the need for rationing of resources
  - Elderly trauma patients use up more resources for less years of life saved
  - Cost per patient and length of stay is longer than other age groups
  - Trauma care reimbursement is inadequate (Sartorelli)
- 3rd peak of death
  - More focus needs to be placed on prevention of end organ damage, ARDS, and sepsis during the resuscitation phase to effectively decrease mortality

Elder Abuse
- 4% of the elderly population
- Contributing conditions
  - Recent changes in family structure
  - Cognitive deficits
  - Failing physical health
  - Financial burdens
- Signs of neglect
  - Poor hygiene, soiled clothing, dehydration
- May take the form of psychological abuse in 44% of patients (Jones)
- Low threshold for social services consult

PATHOPHYSIOLOGY OF TRAUMA IN THE ELDERLY

Consequences for Management

“Stiff Grown-ups”
- Cardiovascular
- Respiratory
- CNS
- Skeletal

Physiologic Changes in the Elderly
Central Nervous System
- Higher mortality rates
- Poorer functional outcome
- Lower incidence of cerebral contusions
- Epidural hematomas are rare
- Subdural hematomas are more common with age
  - Cerebral atrophy: 10% weight loss of brain between 30 and 70 y.o. allowing for greater displacement with injury
  - Increased fragility of bridging veins
  - Blood vessels lack tortuosity and are firmly adherent to both the dura and the mobile cerebral hemisphere
  - The dura becomes more adherent to the skull
  - Mean volume of blood is larger
  - More midline shift
- Coagulopathy/anticoagulation increase the risk of ICH

Physiologic Changes in the Elderly
Musculoskeletal System
- Most frequently injured system in the elderly patient
- Increased bone fragility and increased propensity for falling
- 15% of women > 65 y.o. have osteoporosis (15 million people in the United States)
  - 30% will sustain a fracture by age 75
- Bone pathology is common
  - Osteoporosis, Paget's disease, infection, metastatic disease, marrow dysplasia

Physiologic Changes in the Elderly
Spine
- More prone to falls
- Degenerative changes
- Spinal immobility
- Osteoporosis
- Predisposed to fractures with minimal trauma

Physiologic Changes in the Elderly
Cardiovascular
- Less responsive to circulating catecholamines
- Hypovolemia is often compensated by increases in SVR rather than increased cardiac output
- Underlying coronary disease creates the risk for myocardial ischemia
  - Hypoxia
  - Anemia secondary to blood loss
  - Hypotension
- Anatomical changes
  - Decreased cardiac output
  - Decreased cardiac reserve
  - Inability to mount a response (elevated heart rate) to stress and trauma

- Patients may have normal vital signs and have severely depressed cardiac output

Physiologic Changes in the Elderly
Respiratory
- Reduction in vital capacity and FEV_1
- Decline in the arterial PaO_2 level
- Degeneration leads to joint fusion with loss of compliance of the chest wall
- Osteoporosis resulting in rib fractures with lesser mechanism
- Brittle chest wall
- Higher risk of complications after blunt chest trauma
  - Splinting, hypoventilation, atelectasis
  - Pneumonia
- Weakened intercostal and accessory muscles of respiration
- Decreased lung compliance results in significant pulmonary contusions
- Increased work of breathing
- More susceptible to respiratory failure
- Thoracic injuries may be lethal
- Minor chest injuries may result in significant complications

Airway Anatomical Differences
- Edentulous
- Brittle teeth
- Well-fitting dentures make bag-valve-mask ventilation easier
- Remove loose fitting dentures
- Mouth may not open wide
- Cervical spine immobility
- May need Miller blade which provides more room for visualization

Physiologic Changes in the Elderly
Renal
- Decreased creatinine clearance
- Decreased ability to clear IV contrast dye

Effect of Medications
- Diuretics
  - Chronic volume contraction
  - Potassium depletion
- Beta-blockers, calcium channel blockers

MECHANISM OF INJURY

- Fall is the most common mechanism
- MVC is the second most common mechanism
- Auto-pedestrian accidents

Falls
- Account for 40% of trauma in patients > 65
- 5% result in a fracture
- 11.7% fatality rate
- 10% lead to major injuries
- 3.8% of elderly patients have a significant fall each year
- Usually ground level falls rather than falls from great heights
- Most occur in the home

- 25% are due to underlying medical problem
- Look for an underlying cause requiring admission
    - Syncope or near-syncope
    - CVA
    - Blood loss
        - Anemia, GI hemorrhage, AAA
    - Medications
    - Elderly abuse
- 50% of patients admitted for a fall die within a year
- Falls $\leq$ 1 meter from standing, upright, or horizontal position in Finland
    - Adults $\geq$ 50 y.o.
    - 284% increase in the number of fall-induced injuries from 1970 to 1995
    - 68% of the injuries are fractures
    - 80% increase in the number of deaths from 1970 to 1995
    - Preventive measures are necessary (Kannus)

Patients with Head Injury After a Fall

- 189 patients $\geq$ 60 y.o.
- 16% had an abnormal head CT, 2% required neurosurgery
- Cerebral contusions (36%) and subdural hematomas (33%)
- 76% had falls from a standing position, 19% had a fall on stairs, 5% had a fall from a height
- Fall from a height (40%) or on stairs (42%) were more likely to result in an abnormal CT
- Abnormal neuro exam was associated with a higher risk of the need for neurosurgery (risk ratio 11.5)
- The authors conclude that an abnormal neurologic examination is a strong predictor of the need for neurosurgical intervention
- (Nagurney, JEM 1998)

Low Falls (< 20 ft)

- In this recent study of 176 patients, the mortality rate was 8% (14 patients)
- Of these, half were in patients > 60 y.o., most of these deaths were due to head injury
- The authors conclude that low falls can result in significant injury and that elderly patients with this mechanism should be transported to a trauma center (Helling)

Motor Vehicle Accidents

- Account for 28% of all trauma in the elderly
- 21% fatality rate
- Accidents are more likely to occur
    - In the daytime
    - Close to home
    - At an intersection
    - Involving 2 cars
- Less likely to involve alcohol, reckless driving, or excessive speeds
- 18% due to syncope (Rehm, Am Surg, 1995;61:435-7)
- In another study by Rehm 57% (33 patients) had no known cause of their MVC
    - 25 patients (76%) had subsequent work-ups for syncope that were positive
    - (Am Surg, 1995;61:1006-8)
- Higher risk of sternal fractures than younger patients

Auto-Pedestrian Accidents

- Account for 10% of trauma in the elderly
- 33% fatality rate
- Second only to children

- Injuries are more common
- Hospital stays are longer
- Mortality is greater

CLINICAL PRESENTATION: SPECIFIC INJURIES

Head Injury in the Elderly

- Most common mechanism is fall
- Mortality is higher
- Assessment is more difficult
    - Often an accurate history is unavailable
    - Changes from "baseline" mental status can be subtle
    - The presentation of subdural hematomas may mimic dementia
- Because of cerebral atrophy, elderly patients may harbor IC hematomas with subtle mental status changes
- Anticoagulation
- Low threshold to perform CT scan in any patient with head trauma and mental status changes (even when thought to be chronic)
- Predictors of mortality in patients with subdurals
    - 60% had no focal neurologic findings
    - 31% hospital mortality
    - Factors associated with hospital mortality: GCS $\leq$ 7, age $\geq$ 80, acute SDH, craniotomy (Rozzelle)
- Chronic subdurals
    - Isodense on CT after 7-20 days
    - Look for compression of the ipsilateral ventricle and midline shift
    - Contrast CT or MRI
- In one recent study
    - 20% positive head CT rate
    - Older women were more at risk for the need for neurosurgery
    - Falls were the predominant mechanism
    - Focally abnormal neurologic examination was associated with an increased risk of a positive CT and the need for neurosurgery
    - (Nagurney, Acad EM 1998)

Anticoagulated Patients with Minor Head Injury

- Elderly patients who are anticoagulated may be at increased risk of IC hemorrhage
- Patients without LOC, amnesia, or acute neurologic abnormality
- 38 patients with PTs of 12-30.7
- No cases of IC hemorrhage by CT or follow-up
- The authors conclude that the incidence of clinically significant IC injury is extremely low
- CT may not be necessary (Garra)

Chest Injuries in the Elderly

- Similar types of fractures compared with younger patients
- Higher incidence of sternal fractures
- Rib fractures and flail chest
    - Complicated by atelectasis and ultimately pneumonia
    - Pulmonary contusions are common
    - Less physiologic reserve with risk of worsening hypoxia
    - Higher mortality with pulmonary contusions
- Higher mortality rates

Abdominal Injuries in the Elderly

- Up to 1/3rd of geriatric trauma patients
- Mortality rate is 4 times greater than for younger patients
- The elderly are less tolerant of shock

Orthopedic Injuries
Predominant fractures

- Proximal humerus fractures
  - 30% of upper extremity fractures
  - Twice as frequent in women as men
  - Treatment: sling
- Radial head fractures
  - Most common elbow fracture
  - Elbow fractures and dislocations account for 15% of upper extremity fractures
- Distal radius fractures
  - Most common upper extremity fracture
- Hip fractures
  - Most frequent cause of admission for trauma in the elderly
  - Mortality is 13% to 30% in the first year after the fracture
  - Subtle presentations are common
- Ankle fractures
  - 25% of all lower extremity fractures
  - Lateral malleolus fractures are the most common type

Pelvic Fractures

- 25% of lower extremity fractures
- Single ramus fractures are the most common type
  - Standing height fall
- Bleeding may occur with displacement
- Major pelvic fractures cause significant mortality
  - For stable, closed pelvic fractures mortality is 16%
  - For open fracture with significant hemorrhage 80% or greater

Pelvic Fractures: Comparison Between Age Groups

	Elderly	Young
Leading Mechanism	Fall	MVA
Type of Fracture	Less common: iliac FX	
Associated Injuries	Chest more common	Multiple injuries more common
OR interventions	6%	43%
Mortality	11%	3%

Alost T, Am J Emerg Med, 1997

Cervical Spine Injuries

- Upper cervical spine injuries are the most common
  - Odontoid fractures are the most common
- Odontoid fractures
  - Low-energy mechanism
- Central cord syndromes are more common
  - Hyperextension injuries and buckling of the ligamentum flavum particularly in patients with rheumatoid arthritis
  - Do not recover as well as younger adults
- Mortality of 26%

Lumbar Spine Injuries

- Severe pain without trauma history
- May require admission for pain control
- May be hard to determine the age of a fracture
- Bone scan, CT

Soft Tissue Injuries
- Increased risk of tetanus
- 70% of all tetanus occurs in the elderly
- Low threshold for tetanus prophylaxis

Burns
- Mortality = age plus percentage of body surface burned
- Burn size correlating with a 50% survival rate: 67% TBSA (21-40 y.o.) vs. 25% (> 71 y.o.) [Santora]
- High complication rate
- Deeper burns
  - Poor reaction time
  - Atrophic skin
- Near 100% mortality for burns > 70% TBSA
- $30 million per year is billed for the care of older women with cooking-related ignition of their clothing (Ryan)
  - Implications for prevention
- Probability of death
  - Retrospective study of 1,665 patients with prospective validation
  - Risk factors for death: TBSA > 40%, age > 60, inhalation injury
  - Mortality rates: .3%, 3%, 33%, 90% for patients with 0, 1, 2, or 3 risk factors
  - Ryan, 1998
- Patients > 80 y.o.
  - 41% mortality rate
  - For patients who died: mean TBSA was 32%
  - 5/12 deaths were in patients with burns < 20% TBSA
  - Even small burns cause death in this age group and may require hospital admission (Hammond)

ED EVALUATION OF THE ELDERLY TRAUMA PATIENT

History
Key Questions
- What happened before the trauma?
- What medication is the patient taking?
- What underlying illness is present?
- How many cars were involved in the accident
  - If single car, assume the accident was triggered by an acute medical event

Physical Examination
Vital Signs: Temperature
- Obtain an accurate core temperature
- Hypothermia can exist for many reasons
  - Slowed basal metabolic rates
  - Decreased fat stores
  - Delays in accessing medical attention

Vital Signs: Blood Pressure and Pulse
- Limited physiologic reserve

- Falsely normal pulse
    - Less responsive to circulating catecholamines because of beta-receptor insensitivity
    - Underlying medication such as beta-blockers or calcium-channel blockers
- Falsely normal blood pressure
    - "Normal" values in a patient with baseline hypertension
    - Maintained by increases in SVR because of poor cardiac response to hypovolemia
- Hypotension is a late sign of shock

Laboratory Studies
- Serial hematocrit levels
    - Follow to detect occult hemorrhage
    - Transfuse to maintain at a slightly higher level to improve oxygen carrying capacity and theoretically limit ischemic insult
- Medication levels
- PT/PTT
- Glucose, narcan for mental status change
- ECG

Spine
- May be difficult to clear cervical spine
    - May require CT or MRI to clear
- Low threshold for plain radiographs of the thoracic and lumbar spine

Assessing the aorta
- Chest radiograph
    - Widened mediastinum
        - Sensitivity 54 - 92%
        - Specificity 10%
        - Less reliable in the elderly
        - In one small study, 2/3^{rds} of the patients > 65 y.o. with traumatic aortic injury had a normal mediastinum on cxr (Gundry)
- Dynamic chest CT
- Aortography
- Transesophageal echocardiography

Blunt Myocardial Injury
- Patients greater than 60 y.o. are at increased risk for complications (dysrhythmia and cardiac failure)
    - In one prospective study, all of the complications occurred in patients > 60 y.o. or with otherwise significant chest injury (i.e. $\geq$ 4 rib fractures, pulmonary contusions, flail chest, major vascular injury or severe associated injuries) [Cachecho]
- Lower threshold for ordering ECG and admission for cardiac monitoring

Abdominal Injuries in the Elderly
- Physical exam is unreliable
- In view of the occult presentations and rapid deterioration, bedside assessment is often needed before CT scan
    - DPL
    - Bedside ultrasound
- Lower threshold for CT scan

Hip Pain
- Patients with hip fractures may have only minor pain and still be ambulatory
    - If radiographs are negative but pain is present on range of motion consider CT scan/MRI/bone scan to rule out stress fracture
- Hip radiographs

- Examine carefully for small cortical defects and trabecular pattern disruption
- *Shenton's line* should be uninterrupted
    - Curvilinear line from the inferior femoral neck to the inferior aspect of the superior ramus
    - Femoral neck fractures

MANAGEMENT OF THE ELDERLY TRAUMA PATIENT

Prehospital Management

- Short field times are essential
    - Worse tolerance of prolonged shock or hypoxemia
    - Avoid hypothermia
        - Impairs coagulation
        - Increases risk of dysrhythmia
- Obtain as much history from witnesses without delaying transport
    - Evidence for syncope
    - Other causes of trauma (single car accident)
    - Events preceding the trauma
    - Changes in medication
    - Phone numbers of family and health care providers
- Look for signs of elder abuse

Prehospital Management

- Liberal use of oxygen
- Clear the airway
    - Remove dentures
- Warm blankets
- Immobilize the cervical spine (increased incidence of injury)
- Glucose and naloxone in any patient with altered mental status
- Assume that altered mental status is due to hypoxia, shock, head injury
- Stabilize extremity fractures
- Low threshold for transportation to a trauma center
- Elderly trauma patients are frequently undertriaged to trauma centers

ED MANAGEMENT

- Patients may remain stable for a while and crash fast
- Occult cardiogenic shock
    - Low flow state
    - Oxygen debt
- High-risk for complications:
    - Auto-pedestrian
    - Initial SBP < 130 mmHg
    - pH < 7.35
    - Multiple long bone fractures
    - Head injury (Kohl)
    - These patients have tissue oxygen deficits
    - Failure to recognize the oxygen debt will result in death
- Early aggressive invasive monitoring in an ICU
- Limit the initial work-up to only those tests that are absolutely necessary
- Protocol:

- Initial primary survey, portable radiographs (c-spine, cxr, pelvis), DPL, defer all x-rays that can not be done as a portable, only patients with evidence of head injury undergo head CT
- Patients then undergo invasive monitoring in an ICU before further work-up (Kohl)

Airway
- Threshold to intubate should be inversely proportional to age
  - Occult presentations
  - Higher risks of aspiration and hypoxia
  - Rapid deterioration
- Indications
  - Falling O_2 saturation and chest trauma
  - Altered mental status
  - Any evidence of hemodynamic instability

Basic Airway Rules
- Protect the cervical spine
- Recognize the difficult airway
- Don't be afraid of RSI
- Adapt RSI dosages to age
- 2 intravenous lines that work
- Monitor ECG and O2 sat

Airway Management
Difficult Intubations
- Dentures
- Rheumatoid Arthritis
- Oropharyngeal malignancies
- Radiation therapy
- Neck Surgery
- COPD
- Coronary artery disease

Dosage of Rapid Sequence Intubation for Elderly Patients
- Avoid priming dose of paralytic (may abolish ventilation and airway reflexes)
- Succinylcholine: 1.5 mg/kg (no change required)
- Etomidate: Decrease to 0.1 - 0.2 mg/kg
- Thiopental : Avoid if possible, decrease to 2mg/kg
- Ketamine: Avoid because of increased cardiac oxygen demand
- May be more sensitive to sedation and induction agents
  - Reduce the doses of barbiturates, benzodiazepines, and etomidate by 20-40%

Breathing
- Decrease in the baseline arterial oxygen tension
  - Decrease in diffusion capacity, changes in ventilation-perfusion mismatch
  - $Pa0_2 = 103.7-.24(age) \pm 7.9$ mmHg
- Pneumothorax
- Hemothorax
- Pulmonary contusions

Chest Injuries in the Elderly
- Early airway management for patients with pulmonary contusions or flail chest
- Admission for elderly patients with more than 2 rib fractures for O_2 and observation
- Liberal use of pain medication and incentive spirometry to avoid pneumonia in patients with rib fractures

Fluid Resuscitation
- Recognize early shock states
- Differentiate hypovolemic, cardiogenic, and neurogenic shock
- Avoid fluid overload
  - Consider multiple small fluid boluses
- Ringer's lactate versus normal saline
  - No difference in outcome
  - Risk of hyperchloremic acidosis with NS in patients with worsening renal function
  - NS is less expensive
- Level I rewarmers when-ever possible
- Monitor urine output and pulse oximetry
- Low threshold for blood transfusion

Major Pelvic Fractures
- Early Blood transfusion
- Pelvic stabilization
  - In the ED: MAST trousers
  - Emergent external fixation if any displacement

Invasive Monitoring
- Early invasive monitoring of systemic perfusion indicators
- Pulmonary artery catheter or CVP line
- Early monitoring within 2.2 hours vs. 5.5 hours after admission
  - Patients at high risk for mortality (auto-pedestrian, SBP < 150 mmHg, acidosis, multiple fractures, head injury)
  - Low initial cardiac output and mixed venous oxygen saturation despite normal vital signs
  - Patients who survived were able to increase their cardiac output and mixed venous oxygen saturation
  - Survival rates improved from 7% to 53% (Scalea)
- Consider ICU admission for any patient with anything but minor trauma

Head Injury Patients in Coma
- Involve the family early in decisions about aggressive management
  - Especially if ICP is elevated

PREVENTION

Falls
- Home safety measures
- Bed height
- Lighting
- Bathroom safety (rubber tub mats, grab bars)
- Handrails on stairs
- Balance and strength training
- Home assessments to reduce risk factors (medication use, gait abnormalities)

Interventions to Prevent Recurrent Falls
- Post-fall study including an environmental assessment by a nurse practitioner
- Care discussed with the primary care physician
- After 2 years, 26% fewer hospitalizations, 52% reduction in hospital days, 9% fewer falls, 17% fewer deaths (Rubenstein)
- Outpatient referrals to gerentologist, neurologists, physiatrists

- Identify and monitor patients at high risk for falling (history of previous falls, > 90 y.o.) [Myers]

Auto-Pedestrian Accidents
- Increase crossing time at crosswalks
- Modification of crosswalk signs
- Can result in a reduction of fatal (by 43%) and serious injury (by 86%) [Retting]

MVC Prevention
- Identify unsafe drivers
- Visual or hearing deficits
- Dementia
- Medications

CONCLUSIONS

- "The need for speed"
  - Short prehospital times
  - Early airway management
  - Early transfusion
  - Bedside diagnosis of abdominal injury
- Minor trauma often results in significant injury
- Low threshold for transfer to a trauma center and ICU admission
- "Not just a grayer adult"
  - Underlying cause
  - Elder abuse
  - Beware of myocardial ischemia

REFERENCES:

1. Adelman RD, Berger JT, Macina LO: Critical care for the geriatric patient. Clin Geriat Med 10:19-30;1994.
2. Alba E, Youngberg R: Occult fractures of the femoral neck. Am J Emerg Med 10:64, 1992.
3. Alexander BH, Rivara FP, Wolf ME. The cost and frequency of hospitalization for fall-related injuries in older adults. Am J Public Health 1992;82:1020-1023.
4. Alost T, Waldrop RD: Profile of geriatric pelvic fractures presenting to the emergency department. Am J Emerg Med 15:576;1997.
5. Appleton W: Elder Abuse--diagnose, treat, cure. Ann Emerg Med 17:1104, 1988.
6. Broos TL, Stappaerts KH, Rommens PM: Polytrauma in patients sixty-five and over: Injury patterns and outcome. Int Surg 73:119-122, 1988.
7. Cachecho R, Grindlinger GA, Lee VW. The clinical significance of myocardial contusion. J Trauma, 1992;33:68-73.
8. Champion HR, Copes SW, Buyer D, et al: Major trauma in geriatric patients. Am J Public Health 79:1278, 1989.
9. Bullock C: Elder abuse: denied, ignored, underreported. Emergency Medicine News, Jan 1997, p 28.
10. Cagetti B, Cossu M, Pau A, et al: The outcome from acute subdural and epidural intracranial hematomas in very elderly patients. Br J Neurosurg 6:227, 1992.
11. Cassel CK, Rudberg MA, Olshansky SJ. The price of success: Health care in an aging society. Health Affairs 1992;11:87-99.
12. Demarest GB, Osler TM, Clevenger FW: Injuries in the elderly: Evaluation and initial response. Geriatrics 45:36, 1990.
13. DeMaria EJ, Kenney PR, et al: Survival of trauma in geriatric patients. Ann Surg 206:738-743, 1987.
14. DeMaria EJ: Evaluation and treatment of the elderly trauma victim. Clinics in Geriatric Medicine Vol. 9(2); May 1993.

15. DeMaria EJ, Kenney PR, et al: Aggressive trauma care benefits the elderly. J Trauma 27(11):1200-1206, 1987.
16. Eastwood HD: Delayed diagnosis of femoral neck fractures in the elderly. Age Aging 16:378, 1987.
17. Ellis GL: Subdural hematoma in the elderly. Emerg Med Clin North Am 8:281, 1990.
18. Finilli FC, Jonsson J, et al: A case control study for major trauma in geriatric patients. J Trauma 29(5):541-548, 1989.
19. Fogelholm R, Heiskanen O, Waltimo O. Chronic subdural hematoma in adults: Influence of patient's age on symptoms, signs, and thickness of hematoma. J Neurosurg 1975;42:43-47.
20. Garra G, Nashed A, Capobianco L. Minor head trauma in anticoagulated patients. Acad Emerg Med 1999;6:121-124.
21. Gin-Shaw S, Jordan R. Multiple trauma. In Rosen P and Barkin R (eds) Emergency Medicine Concepts and Clinical Practice, St. Louis, 1998, Mosby.
22. Gundry SR, Burney RE, McKenzie JR, et al: Indications for aortography in blunt thoracic trauma: A reassessment. J Trauma 22:664, 1982.
23. Hammond J, Ward CG. Burns in octogenarians. South Med J 1991;84:1316-9.
24. Helling TS, Watkins M, Evans LL, et al. Low falls: an underappreciated mechanism of injury. J Trauma 1999;46:453-6.
25. Hogue CC: Injury in late life: Part I - Epidemiology. J Am Geriatr Soc 30:183-190, 1982.
26. Horst HM, Obeid FN, Sorenson VJ, et al: Factors influencing survival of elderly trauma patients. J Trauma 14:681, 1986.
27. Howard MA, Gross AS, Dacey RG, et al: Acute subdural hematomas: An age-dependent clinical entity. J Neurosurg 71:858, 1989.
28. Jerred DA, Cappadoro K: Burns in the elderly patient. Emerg Med Clin North Am 8:421, 1990.
29. Jones J, Dougherty J, Schelbe D, et al: Emergency department protocol for the diagnosis and evaluation of geriatric abuse. Ann Emerg Med 17:1006, 1988.
30. Kannus P, Parkkari J, Koskinen S. Fall-induced injuries and deaths among older adults. JAMA 1999;281:1895-1899.
31. Kiel DP, Eichorn A, Intrator O, et al: The outcomes of patients newly admitted to nursing homes after hip fracture. Am J Public Health 84:1281, 1994.
32. Kim SK, Hemmati M, Weinberg PE: Computed tomography in isodense subdural hematoma. Radiology 128:71, 1978.
33. Knudson MM, Lieberman J, Morris J, et al: Mortality factors in geriatric blunt trauma patients. Arch Surg 129:448, 1994.
34. Kohl L, Scalea TM. Trauma in the elderly. In Harwood-Nuss AL (ed) The clinical practice of emergency medicine, Philadelphia, 1996, Lippincott-Raven Publishers.
35. Kong LB, Lekawa M, Navarro RA, et al: Pedestrian-motor vehicle trauma: An analysis of injury profiles by age. J Am Coll Surg 182:17, 1996.
36. Lakatta EG: Age related alterations in cardiovascular response to adrenergic mediated stress. Fed Proc 30:3173-3177, 1980.
37. Lehman LB: Head trauma in the elderly. Postgrad Med 83:140, 1988.
38. Lieberman IH, Webb JK: Cervical spine injuries in the elderly. J Bone Joint Surg 76:877, 1994
39. Levy DB, Hanlon DP, Townsend RN: Geriatric trauma. Clin Geriatr Med 9:601-620;1993.
40. MacKenzie EJ, Morris JA, Edelstein SL. Effect of pre-existing disease on the length of hospital stay in trauma patients. J Trauma 1989;29:757-64.
41. Mandavia D, Newton K: Geriatric trauma. Emerg Med Clin North Am 16:257; 1998.
42. Martin RE, Teberian G: Multiple trauma and the elderly patient. Emerg Med Clin North Am 8:411, 1990.
43. McCoy GF, Johnstone RA, Duthie RB: Injury to the elderly in road traffic accidents. J Trauma 29:494, 1989.
44. Melton JL, Sampson JM, Morrey BF et al: Epidemiologic features of pelvic fractures. Clin Orthop Rel Res 155:43, 1981.
45. Meyers AH, Robinson EG, Van Natta ML, et al: Hip fractures among the elderly: Factors associated with in-house mortality. Am J Epidemiol 134:1128, 1991.
46. Miller MD: Orthopedic trauma in the elderly. Emerg Med Clin North Am 8:325, 1990.

47. Milzman DP, Rothenhaus TC. Resuscitation of the geriatric patient. Emerg Med Clin North Am 1996;14:233-244.
48. Morris JA, MacKenzie EJ, Edelstein SL: The effect of preexisting conditions on the mortality in trauma patients. JAMA 263:1942, 1990.
49. Oreskovich MR, Howard JD, et al: Geriatric trauma: Injury patterns and outcome. J Trauma 24(7):565-572, 1984.
50. Osler T, Hales K, Baack B, et al: Trauma in the elderly. Am J Surg 156:537, 1988.
51. Pellicane JV, Byrne K, DeMaria EJ: Preventable complications and death from multiple organ failure among geriatric trauma victims. J Trauma 33(3):440-444, 1992.
52. Pennings JL, Bachulis BL, Simons CT, et al: Survival after severe brain injury in the aged. Arch Surg 128:787, 1993.
53. Perdue PW, Watts DD, Kaufmann CR, et al. Differences in mortality between elderly and younger adult trauma patients: geriatric status increases risk of delayed death. J Trauma 1998;45:805-10.
54. Rehm CG, Ross SE: Elderly drivers involved in road crashes: A profile. Am Surg 61:435, 1995.
55. Retting R, Schwartz SI, Kulewiicz M, et ak. Queens Boulevard pedestrian safety project, New York City. MMWR 38:61, 1989.
56. Ross AM, Pitts LH, Kobayashi S, et al. Prognosticators of outcome after major head injury in the elderly. J Neurosci Nurs 24:88, 1992.
57. Rozzelle CJ, Wofford JL, Branch CL: Predictors of hospital mortality in older patients with subdural hematoma. J Am Geriatr Soc 43:240;1995.
58. Rubenstein LA, Robbins SA, Josephson DR, et al. The value of assessing falls in an elderly population: a randomized clinical trial. Ann Intern Med 1990;15:113.
59. Ryan CM, Schoenfeld DA, Thorpe WP, et al. Objective estimates of the probability of death from burn injuries. NEJM 1998;338:362-366.
60. Santora TA, Schinco MA, Trooskin SZ: Management of trauma in the elderly patient. Surg Clin North Am 74:163, 1994.
61. Sartorelli KH, Rogers FB, Osler TM, et al. Financial aspects of providing trauma care at the extremes of life. J Trauma 1999;46:483-7.
62. Scalea TM, Simon HM, et al: Geriatric blunt multiple trauma: Improved survival with early invasive monitoring. J Trauma 30:129-136, 1990.
63. Schwab CW, Kauder DR: Trauma in the geriatric patient. Arch Surg 127:701, 1992.
64. Shabot MM, Johnson CL: Outcome from critical care in the "oldest old" trauma patients. J Trauma 39:254, 1995.
65. Shorr RM, Rodriguez A, Indeck MC, et al: Blunt chest trauma in the elderly. J Trauma 29:234, 1989.
66. Smith DP, Enderson BL, Maull KI: Trauma in the elderly: Determinants of outcome. South Med J 83:171, 1990
67. Spallone A, Giuffre R, Gagliardi FM, et al: Chronic subdural hematoma in extremely aged patients. Eur Neurol 29:18, 1989.
68. Spencer, G: Projections of the population of the United States by age, sex, and race: 1988 to 2080.
69. Tornetta P, Mostafavi H, Riina J, et al. Morbidity and mortality in elderly trauma patients. J Trauma 1999;46:702-6.
70. Traynelis VC. Chronic subdural hematoma in the elderly. Clin Geriatr Med 1991;7:583-589.
71. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988;319:1701-1707.
72. Washington D.C.: Bureau of the Census, 1989. Current population reports. Series P-25. No. 1018.
73. Van Aalst JA, Morris JA, et al: Severely injured geriatric patients return to independent living: A study of factors influencing function and independence. J Trauma 31(8):1096-1102, 1991.
74. Zietlow SP, Capizzi PJ, Bannon MP, et al: Multisystem geriatric trauma. J Trauma 37:985, 1994.