

On January 1, 2011, the first of the Baby Boomers turned 65 years old, and every single day for the next 19 years more than 10,000 Baby Boomers will reach the age of 65.



Your elderly trauma patient (defined by the ACS as over 55 years old) may range from

- a 55 year old with chronic renal failure on dialysis who lives in an Adult Foster Care home
- an 83 year old who plays tennis three times a week and lives with her husband in a retirement community
- a 68 year old with dementia who lives in a nursing home
- or as in the picture above a 92 year old widow who lives alone and participates with joy in whatever activity she can.

## Objectives

**At the conclusion of this presentation the participant will be able to:**


- List the most common mechanisms of injury in the elderly
- Discuss 4 physiological changes that make the elderly trauma patient vulnerable to complications
- Describe issues with pain control in the elderly
- Describe the effectiveness of rapid reversal protocols in the head injured patient on antithrombotics



While we will be discussing many issues in the care of this very special population, you will notice a common thread throughout the presentation that relates back to these objectives.

## Causes of Mortality


<b>Age 55-64 yrs</b>	<b>Age 65 and over</b>
1. Malignant neoplasms	1. Diseases of heart
2. Diseases of heart	2. Malignant neoplasms
3. Chronic lower respiratory diseases	3. Chronic lower respiratory diseases
<b>4. Unintentional injuries</b>	4. Cerebrovascular diseases
5. Diabetes mellitus	5. Alzheimer's disease
6. Chronic liver disease/cirrhosis	6. Diabetes mellitus
7. Cerebrovascular diseases	7. Influenza and pneumonia
<b>8. Suicide</b>	8. Nephritis, nephrotic syndrome and nephrosis
9. Nephritis, nephrotic syndrome and nephrosis	<b>9. Unintentional injuries</b>
10. Septicemia	10. Septicemia



- Unintentional injury is the 4th leading cause of death in the younger age group, increasing to the 9<sup>th</sup> in the over 65 group.
- The elderly account for only 10-12% of all trauma victims
- But they consume 25% of trauma related health care resources
- They have higher mortality rates
- They have higher complication rates

## Epidemiology

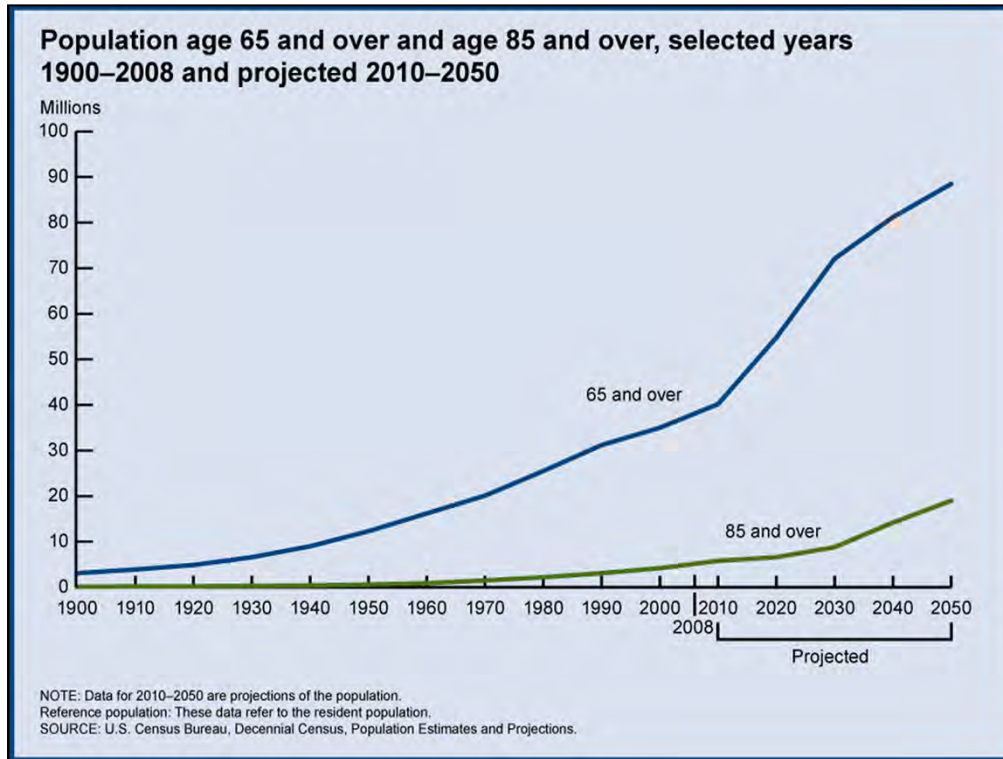
- Average American life span has increased by almost 30 years in the past century
  - 1900's = 47 year old
  - 2000's = 76 years old
- Percent US population over age 64:
  - Currently = 12%
  - By 2050 = > 20%



•The baby boomer generation will swell the ranks of the elderly over the next decades.

•The increased life span expectancy is related to:

- Improved health
- Better nutrition
- Better technology
- Social supports
- Better health care



- This chart shows the large growth of the population 65 and older from 1900 to 2008 and the even greater projected growth from 2008 to 2050.
- It also shows the growing numbers of persons 85 and older and their large projected growth to 2050.
- As the U.S. population ages, the number of geriatric trauma victims will continue to grow.
- This **tsunami** (wave) of geriatric patients are heading our way.....What percentage of geriatric patients now make up your trauma service population?


## Demographics and Trauma

1995

- 10% of all trauma victims were > 65 years old
- 28% of all injury fatalities were > 65 years old

2050

- 40% of all trauma victims will be > 65 years old
- Fatalities will be ....???




- How can we, as trauma professionals, impact these numbers?
- Prevention initiatives are part of the answer.
- Including age criteria in triage protocols may help early identification
- Implementation of specific geriatric trauma protocols may improve outcomes



## What is Geriatric?

- Age  $\geq$  65
  - the classic retirement age
- Age  $\geq$  70
  - geriatric trauma definition
  - based upon stratification of injury survival and age
- Age  $\geq$  75
  - Geriatrician's view
- Physiologic age
  - More importance than chronologic age



- Everyone defines geriatric differently
- Is this 97 year old an example of the “old, old” or the “elderly, elderly”?
- She is frail, walks with a walker, occasionally uses oxygen and is on Coumadin.
- If she falls and breaks a rib, a hip or has an intracranial bleed, she has an expected mortality of 100%

## Most Common Mechanisms of Unintentional Injury



1. Falls
2. Motor Vehicle Crash
3. Burns
4. Pedestrian



- While falls are the most common mechanism of injury
- The most lethal is:  
(answer=Pedestrian)

## Falls

In the next 17 seconds:

- An older adult will be treated in ED for injuries related to a fall

In the next 30 minutes:


- An older adult will die from injuries sustained in a fall



- Most common mechanism and can result in severe injuries such as hip fractures and head traumas.
- Many older adults, even if they have not suffered a fall, become afraid of falling and restrict their activity, which drastically decreases their quality of life.
- As the U.S. population ages, both the number of falls and the costs to treat fall injuries are likely to increase.
- Falls among older adults cost the U.S. health care system over \$20 billion annually
- The economic burden of older adult falls can help make the case for funding prevention programs and reduce overall health care costs. “

## Possible Causes of Falls

- Primary cardiac problems
- Altered BP control
- Ineffective cerebral blood flow
- Metabolic/respiratory derangements
- Balance/musculoskeletal problems
- ETOH
- Polypharmacy



- Brady or tachyarrhythmias may cause dizziness
- Hypotension from antihypertensives (doubling up dose, getting out of bed too fast)
- Hypo or hyperglycemia, hypoxia or hypercarbia may cause altered level of consciousness
- Balance issues may result from deconditioning, vertigo from inner ear issues, arthritis, effects of a stroke, peripheral neuropathies
- As many as 17% of those over 65 years old abuse alcohol
- Combination of medications for pain, anxiety, depression, sleep along with the medications to treat the cardiac, pulmonary, metabolic diagnoses can alter level of consciousness and also negatively impact critical thinking and decision making.



- Then of course we have the environmental issues that can cause a fall.
- How many potentially dangers do you see in this picture?



### **Causes**

- In addition to treatment of the injuries, always work the patient up for the cause of the fall
- 25% due to underlying medical problem
- Which may be more significant than the fall itself
- More trauma services now mandate a geriatric or primary care consult on admission to better co-manage these issues

### **Injuries**

- The most common fall related injuries are:
  - Fractures
  - Head Injury

### **Longterm Outcome:**

- Statistics reveal that up to 50% will die within one year of the a serious fall

## Motor Vehicle Crashes



2nd most common cause of unintentional injury in the elderly

Older adults (>65):

- 16% of all traffic fatalities
- 8% of all injuries



- After falls, MVC's are the most common cause of injury in the elderly
- Older drivers make up 15% of all drivers in US.
- 79% of US MVC fatalities were restrained
- 5% were ETOH impaired
- Interestingly driver fatalities in this age group decreased by 18% between 2000 and 2009.
- This may be a combination of:
  - safer vehicles
  - increased restraint use
  - safer driving
  - improvements in trauma care for the elderly
- **Additional concerns with this picture?**
  - Good example of “distracted” driving. A 67 year old man, talking on his cell phone, his dog in his lap!!!

## Common Patterns Seen in Elderly Crashes

- Turning left into oncoming traffic
- Intersections
- In Good weather
- Close to home
- During the day
- 80% “at fault”



- T-bone mechanisms are more common in the elderly
- Making a left hand turn is difficult at best.
- The driver needs to be aware of three different directions, judge the speed of vehicles coming from those directions, determine if they are going to stop at the stop sign or the light, and judge when it is safe to turn.
- A lot of elderly have trouble with night vision.
- In a 2 car collision, when one car is driven by an elderly person, the elderly person is often at fault



## Increased Effort of Self Protection



- Decrease daily driving
- Avoid driving at night
- Avoid driving at peak hours
- Avoid driving on freeways
- Drive at lower speeds
- Drive larger vehicles
- Carry fewer passengers



- Self protection activities are a normal consequence of aging
- This is due to awareness of changes in their vision, hearing, critical thinking and attention span.

## Next Most Common Mechanisms of Injury

### Burns

- 25% of all burn deaths occur in ages >65
- Elderly have the highest fatality rate among burns

### Pedestrian

- 38% of deaths at a crosswalk
- Females > males
- 50% at night



#### •Burns:

- 3rd leading cause of accidental death in elderly
- More at risk because the elderly tend to live in older housing
- Less likely to have smoke detectors
- Less able to evacuate
- Major inhalation injuries & burns

#### •Pedestrian Injuries:

- Causes
  - Slow pace
  - Gait/balance
  - Visual & Auditory Changes
  - Strength and Coordination

## Intentional Elderly Trauma: Serious Public Health Issue



### Elder Maltreatment

- Classified as: physical, sexual, emotional, neglect, abandonment, and financial
- Often a caregiver
- Frequently underreported
- Frequently undiagnosed
- True incidence unknown

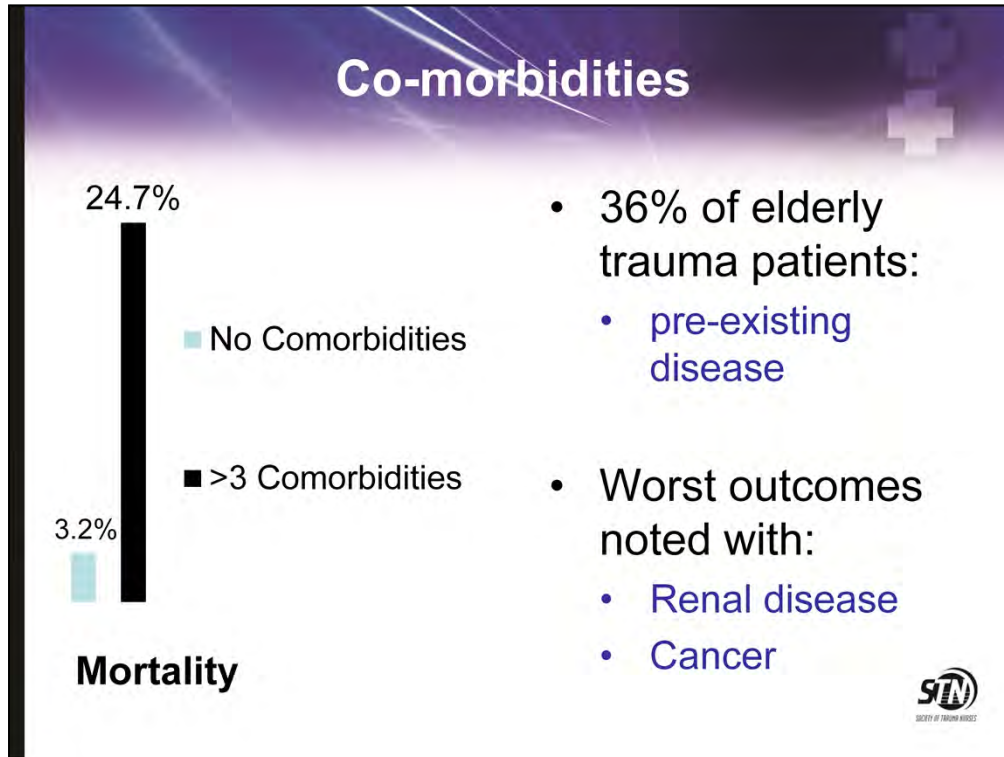


- Violence also impacts the elderly
  - Because the elderly tend to concentrate in urban areas
  - Are more vulnerable to violent crime
- **Elder abuse and neglect** underreported and often missed by health care workers who fail to inquire :
  - Listen to elders and their caregivers
  - Report abuse or suspected abuse to Adult Protective Services
- **Suicide** was the eleventh leading cause of death for all ages
  - But is the highest among elderly males.
  - Males take their own lives at nearly four times the rate of females and represent 78.8% of all U.S. suicides
  - Suicide is a serious public health problem
  - Causes are complex and determined by multiple factors, the goal of suicide prevention is simple: **Reduce factors that increase risk** (i.e. risk factors) and increase factors that promote resilience (i.e. protective factors)

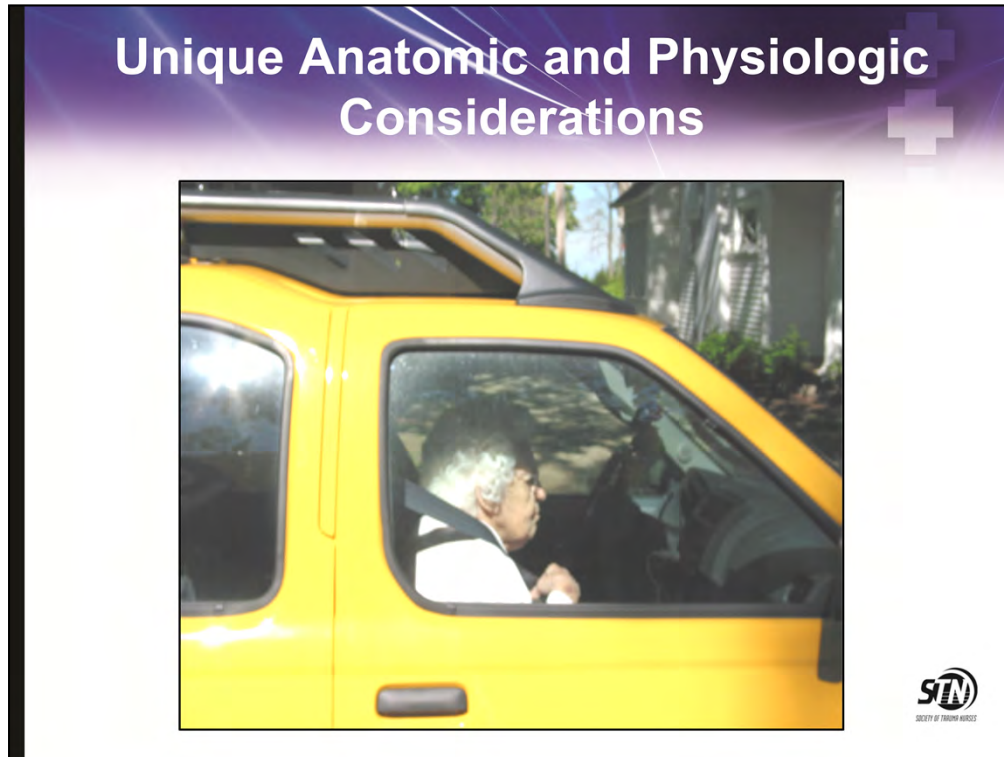
## Suicide

- Males > 75  
Highest Rate of  
Suicide in the  
U.S.
- Among Elderly:
  - 4 attempts
  - For every 1  
suicide






- While injury severity, time to definitive care, and the quality of care in trauma patients have been quantified, it has been much more difficult to quantify pre-existing health status or 'host factors' in trauma patients and relate them to trauma outcome.
- Numerous studies have attempted this task, but none have succeeded in producing a simple system to quantify co-morbidities.
- The risk of a preventable complication in an inpatient setting increases dramatically with the number of chronic conditions.
- Better primary care, especially coordination of care, could help reduce complications and LOS



- While each trauma patient over the age of 65 is considered “elderly”, each has their own unique medical history, physical capabilities, and attitude.
- Two disparate responses to injury:
  - “why did this happen to me?”
  - “how soon after surgery can I start physical therapy?”
- Men and women over 50 with more positive self-perceptions of aging live on average **7.6 years longer** than those with negative perceptions
- It may be impossible for a trauma professional to change the attitude of your patients, but there are certain changes that occur as we age that we do need to keep in mind and plan appropriate assessment and interventions.


## Sensory Considerations

- Decreased:
  - Hearing
  - Vision
  - Taste
  - Smell
  - Tactile sensation


An elderly woman with short, reddish hair and glasses is shown from the chest up. She is looking down intently at a small, thin object she is holding between her fingers. The background is a plain, light color. The image is part of a presentation slide with a purple gradient header.

- Assessing for sensory changes may be difficult
- Especially with:
  - preexisting dementia
  - altered level of consciousness
  - Intubation
  - pharmaceuticals.
- The family/significant others/friends can help.

## Neurologic Considerations



- Declining:
  - Perceptual motor skills
  - Concept formation
  - Complex memory tasks
  - Quick decision tasks
  - Slower reflex times
- Alters response to:
  - Drugs
  - Pain
  - Environment




- With aging the brain and spinal cord lose nerve cells and weight.
- Nerve cells may begin to transmit messages more slowly than in the past.
- Waste products can collect in the brain tissue as nerve cells break down, causing abnormal structures called plaques and tangles to form.
- Slowing of thought, memory, and thinking a normal part of aging.
- Dementia and severe memory loss are NOT normal processes of aging but can be caused by degenerative brain disorders such as Alzheimer's disease.



## Postoperative Cognitive Disorders

Delirium → Post Op Cognitive Decline (POCD) → Dementia

- **Delirium**
  - 10-15% of elderly patients after general anesthesia
- **POCD**
  - Mild neurocognitive disorder presenting as impaired memory or concentration
- **Dementia (rare)**
  - Multiple cognitive deficits
  - Impairment in occupational and social function



**Delirium:** We have all observed older patients who develop delirium after surgery. Delirium is reported to occur in 10-15% of elderly patients who receive general anesthesia.

- Variables associated with delirium include:
  - older age, hypoalbuminemia
  - impaired functional status
  - Pre existing comorbidities.
- pre-existing dementia: most predictive

**POCD:**

- Risk factors for having POCD at 3 months included increasing age, lower educational level, prior stroke and POCD at discharge.
- Effects include: planning , working memory, attention problem solving, verbal reasoning, inhibition, mental flexibility, and multi-tasking.

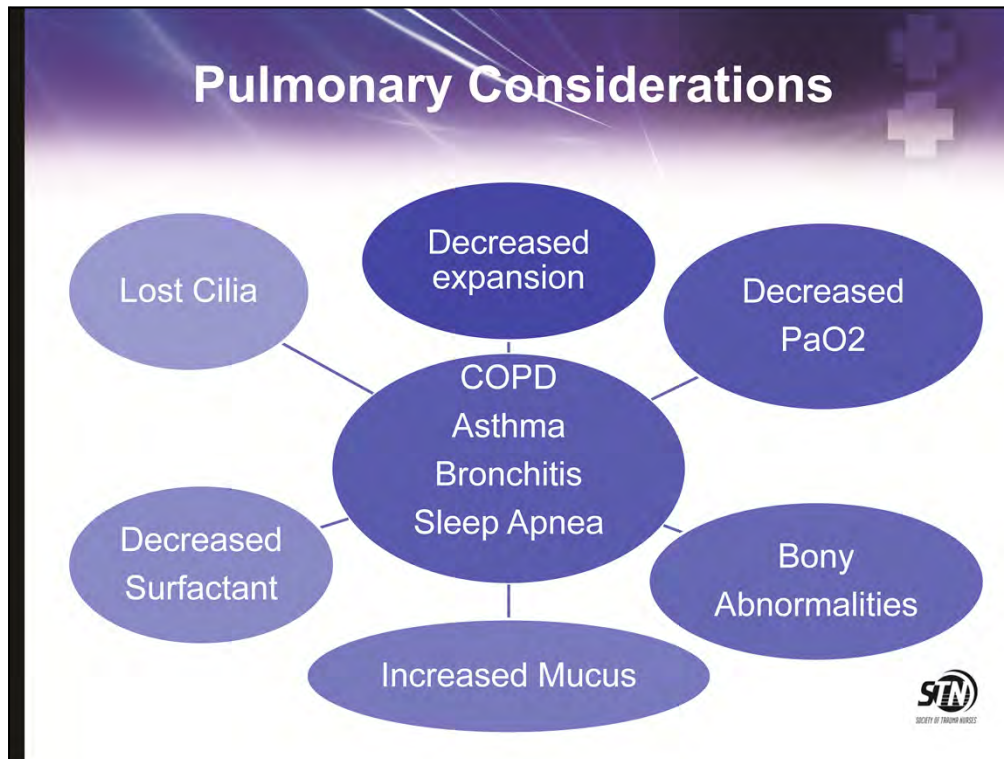
• **Dementia** is extremely rare following surgery and presents with cognitive deficits in multiple domains and severe impairment in occupational and social function.

## Pharmaceutical Considerations

- Start Low and Go Slow
- Avoid:
  - Meperidine (Demerol)
  - Tramadol (Ultram)
- Treat Anxiety and Pain
- Common side effects:
  - Constipation
  - balance issues
  - postural hypotension

An elderly man and woman are looking at three pill bottles on a table. The man is on the left, wearing a blue ring, and the woman is on the right, wearing glasses. The bottles contain yellow, orange, and green pills.

- The average geriatric patient takes 4 or more medications
- Adverse reactions from medications are up to 7 times more common in persons aged 70 to 79 years than in those aged 20 to 29 years.
- The greater the number of medications taken, the greater the risk of a clinically serious drug drug Interaction.”
- Opioids should be started at 25-50% of the adult dose and titrated until pain is reduced to a mild level.



•Your elderly patient, even with healthy lungs, arrives at the hospital with a lower PaO<sub>2</sub>.

•**The common rule of thumb** is to subtract 1 mm Hg from the minimal 80 mm Hg level for every year over 60 years of age: (Note: up to age 90) So a 70 year old patient would have a “normal” PaO<sub>2</sub> of 70 mm Hg.

•Keeping this in mind, remember that until the PaO<sub>2</sub> gets to about 60 mmHG the oxygen saturation stays above 90%. (Google the oxygen dissociation curve for more info.)

•So our elderly patients not only come to us with stiffer pulmonary structures, sticky secretions and comorbidities, they also come to us with diminished reserve (less oxygen available for extraction during times of increased need).


**Some strategies to follow are:**

- Hydration
- Incentive spirometry
- Pain control
- EARLY mobilization
- Monitor SPO<sub>2</sub> and remember that an oxygen saturation of 90 is NOT GOOD.

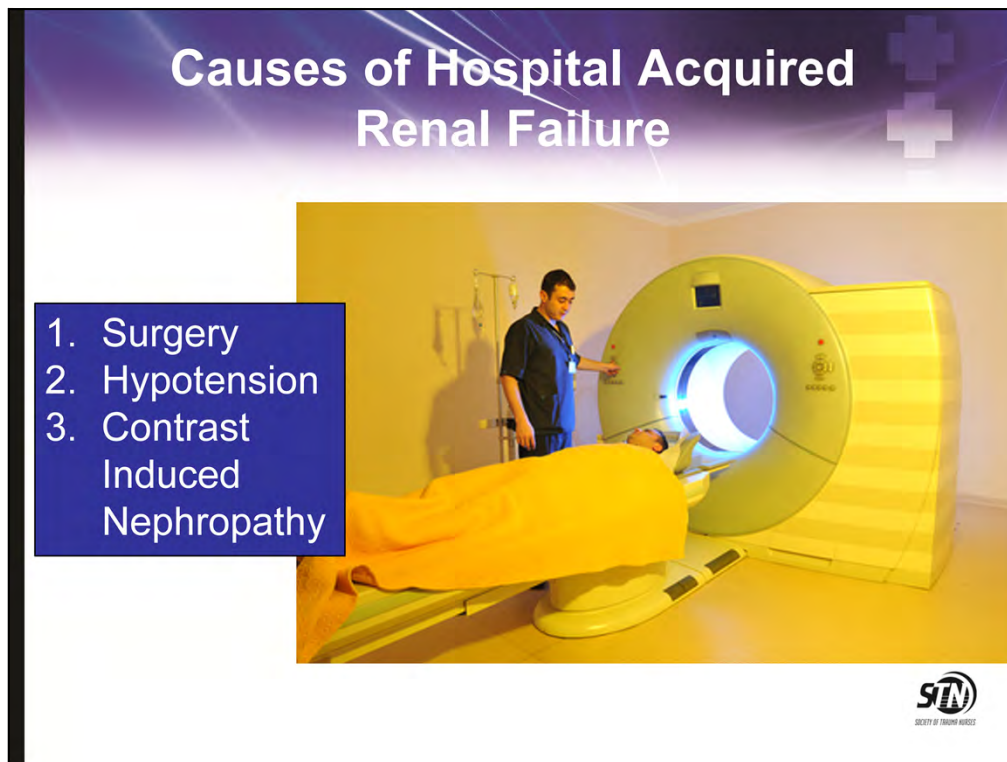
## Renal Considerations

Renal blood flow ↓ 10% per decade  
Steady ↓ in functioning nephrons  
=  
**reduced ability to filter & clear drugs**

Caution:  
Even with normal kidneys:  
hypotension, hypovolemia, nephrotoxicity from IV  
contrast and pharmaceuticals & rhabdomyolysis.



- Our patients may come to us with renal impairment or already on dialysis.
- If already on dialysis, then arrangements for continuation of therapy need to be made.
- Renal Insufficiency defined as :  
Glomerular filtration rate (GFR)<60 mL/min/1.73 m<sup>2</sup>
- Prevention of renal insufficiency and renal failure by awareness of :**
  - categories of nephrotoxic drugs
  - maintenance of optimal blood flow to the kidneys
  - avoiding hypotension
  - monitoring creatinine, CPK & myoglobin
- While not an inclusive list, the following drugs are commonly used in the elderly:
  - ACE inhibitors, Angiotension Receptor Blockers (ARBs), NSAIDS
  - Aminoglycosides and amphotericin B



Those at increased risk include:

Patients with chronic kidney disease

Enhanced with diabetes, dehydration, heart failure, age >70 , and concurrent use of nephrotoxic drugs.

Treatment:

Low-osmolar (Non-ionic) contrast

In the lowest dose possible

Avoidance of multiple procedures in 24 to 48 hours

**Non-ionic agents include Isovue and Visipaque.**

•Before and after the procedure:

•0.9% saline or sodium bicarbonate (154 mEq/L) may be infused

•NSAIDs and diuretics should be withheld at least 24 hours before and after the procedure.

•Renal function should be monitored for 24 to 48 hours after the procedure

•Acetylcysteine (Mucomist) may be considered before and for two days after the procedure.

- Scavenging a variety of oxygen-derived free radicals and improving endothelium-dependent vasodilation are properties of *N*-acetylcysteine that may confer protection against contrast-medium-induced renal dysfunction

- Free-radical formation is promoted by an acidic environment typical of tubular urine but is inhibited by the higher pH of normal extracellular fluid.

- Because free radicals are postulated to mediate contrast-induced nephropathy, alkalinizing renal tubular fluid with bicarbonate may reduce injury.

•The effectiveness of sodium bicarbonate IV and acetylcysteine in prevention of contrast induced nephrotoxicity however remains unproven.

•The incidence of Contrast Induced Nephropathy is relative low.

•Therefore contrast should not be withheld routinely as a nephro protective strategy.

## GI Considerations

- Slowing peristalsis
- Laxative dependence
- Proton Pump Inhibitors (PPIs) and H2 Blockers
  - Decrease gastric acid
- Pernicious anemia
  - Common in elderly



- Increased risk for constipation:
  - change in level of activity
  - decrease in oral fluid intake
  - decrease in fiber intake
  - opiates for pain
  - inability to use a bedpan
- In a population that often depends on a daily laxative (or two), a stool softener prn is not the answer.
- Routine use of a laxative accompanied by a rectal exam and suppository every 48 hours will help avoid the diarrhea of impaction and the onerous duty for you and the patient of disimpacting the patient.
- There is a modest relationship between use of PPIs in the elderly and C Difficile,

## Musculoskeletal Considerations

- ↓ muscle fibers
- ↑ connective tissue
- ↓ bone mass



- Your elderly patient may arrive in your trauma bay with a number of musculoskeletal comorbidities.
- Note the “dowager’s hump” on this great grandmother.
- Osteoporosis is a common cause of compression fractures. Multiple compression fractures can cause kyphosis, the hump-like curvature of the spine.
- A hip fracture is a fracture in the upper quarter of the femur.
- This is a major trauma for an “old-old” patient.
- The outcome in this age group ranges from decrease to loss of independence, to death within the 12 months after the injury.
- The elderly patient may also have had knee or hip replacement..



**Compression fractures** are common in the elderly and may be acute or chronic.

- Acute may be due to an axial load injury such as a fall from a height landing on feet.
- Compression fractures due to osteoporosis may cause no symptoms at first and may only be discovered when x-rays of the spine are done for other reasons.
- Over time, the following symptoms may occur:
  - Back pain that starts slowly, which gets worse with walking but is not felt when resting
  - Loss of height, as much as 6 inches over time
  - Stooped over posture or kyphosis, also called a "dowager's hump"





**The intertrochanteric fracture:**

- common injury seen with low energy falls in the elderly.
- While isolated hip fractures may or may not be admitted by the trauma service, there are some improvement initiatives that will improve the overall surgical care of these patients.
- Collaboration with the orthopedic surgeons, anesthesia and the trauma program can decrease time in the emergency department, decrease the clearance for surgery process, decrease time to internal fixation, decrease length of stay in acute care, improve pain management and discharge planning.

## Musculoskeletal Implications


- Early mobility
- Early PT
- Early Rehab



- Because of the osteoporosis, spondylosis and compression fractures common in the elderly, particularly elderly women it may be difficult to clinically and radiographically to clear C-spine.
- It is also often difficult to properly fit a cervical collar.

## Endocrine Considerations

- Increase in glucose tolerance
- Hypothyroidism
- Menopause
- Continue supplements
- Monitor glucose




**Age Related Changes in the Endocrine System include:**

- Insulin resistance which may prevent efficient conversion of glucose into energy
- A decrease in aldosterone and cortisol may affect immune and cardiovascular function
- Hypothyroidism is common

## Cardiovascular Considerations

<p><u>Primary Concern:</u></p> <ul style="list-style-type: none"><li>• Limited cardiac reserve</li><li>• Unable to increase O<sub>2</sub> delivery to meet demands</li></ul>	<p><u>In the Presence of:</u></p> <ul style="list-style-type: none"><li>• Previous MI</li><li>• Heart Failure</li><li>• Beta blockers</li><li>• Bradyarrhythmias</li><li>• Loss of atrial kick</li></ul>
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**Increasing oxygen delivery requires:**

- Increased heart rate
  - Increased contractility
  - Optimal preload.
  - Optimal afterload (no hypertension or vasoconstriction)
- The patient with a previous MI, with heart failure, taking beta blockers, may not be able to increase heart rate or contractility.
- If the patient is in atrial fibrillation or has a ventricular pacemaker, there is the loss of atrial synchrony (atrial kick).
- The elderly patient is also often dehydrated or has dependent edema sequestering fluid, both of which can decrease preload.

## More CV considerations


- Multiple medications
- Electrical Therapies
- Previous vascular surgery
- IVC filter



- It is very important to continue pharmaceutical therapies.
- Abrupt discontinuation of antiarrhythmics can result in atrial fibrillation with uncontrolled ventricular response.
- Abrupt discontinuation of antihypertensives, ACE inhibitors, Angiotensin Blockers, may lead to a hypertensive episode that is difficult to manage. This could be particularly harmful in a patient with an intracranial bleed.
- If your patient has a pacemaker or an internal cardioverter/defibrillator, the device should be evaluated for proper function after the traumatic event.
- If your patient is taking an anticoagulant for atrial fibrillation, prior valvular surgery, pulmonary embolus, DVT, then an evaluation of the risks and benefits of continuing or when to restart the medication must be made.

## Age as Criteria for Trauma Activation?

- Under triage often lethal
- Injuries often occult
- Initial vital signs unreliable
- Error attributing confusion/pain to pre-existing disease
- Small margin of error
  - Geriatric patient can tolerate
- Increasingly age is being added as a criterion by individual trauma centers



•Some believe that age 70 alone should be a criteria for trauma team activation.

•Others state that patients over the age of 60 years of old with multiple injuries or significant mechanism of injury should be a criteria for the highest level of trauma activation.

•The CDC Field Triage addresses age only after physiologic criteria, major mechanism criteria and fairly minor mechanism criteria and then at the fourth level of the decision tree, suggests “contact Medical Control and consider transport to trauma center.”

**Normal Presenting Vital Signs are often unreliable:**

•Vital signs on presentation are less predictive of mortality in geriatric blunt trauma victims.

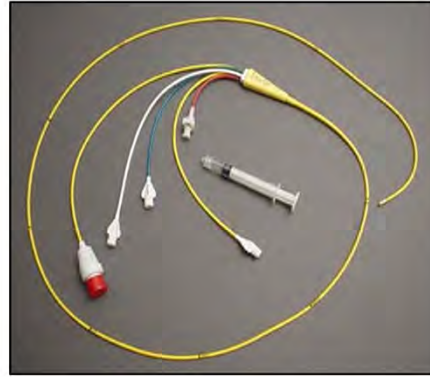
•The elderly are often hypertensive and thus a normal BP may represent a relative hypotension that may be under appreciated

•Geriatric blunt trauma patients warrant increased vigilance despite normal vital signs on presentation.

•New trauma triage set points of HR 90 or SBP 110 mm Hg should be considered in the geriatric blunt trauma patients.

## Resuscitation Considerations

There are no benefits to therapy directed by pulmonary-artery catheter over standard care in elderly, high-risk surgical patients requiring intensive care.



- An alternative to the pulmonary artery catheter (PAC) that has been mentioned in the literature is BEAT (Bedside Echocardiographic Assessment in Trauma).
- There is significant correlation between the Cardiac Index and CVP as derived from the Echocardiogram and measured from the PAC.

## Crystalloid Resuscitation in Elderly



- ED volume replacement of  $\geq 1.5$  L
  - Independent risk factor for mortality
- **Caution:**
  - High-volume resuscitations are associated with particular high mortality in the elderly trauma patient.



- Moderate resuscitation approaches, especially in the elderly, may increase survival in trauma patients.
- Excessive fluid resuscitation should be avoided in the ED and when required, operative intervention or ICU admission should be considered.

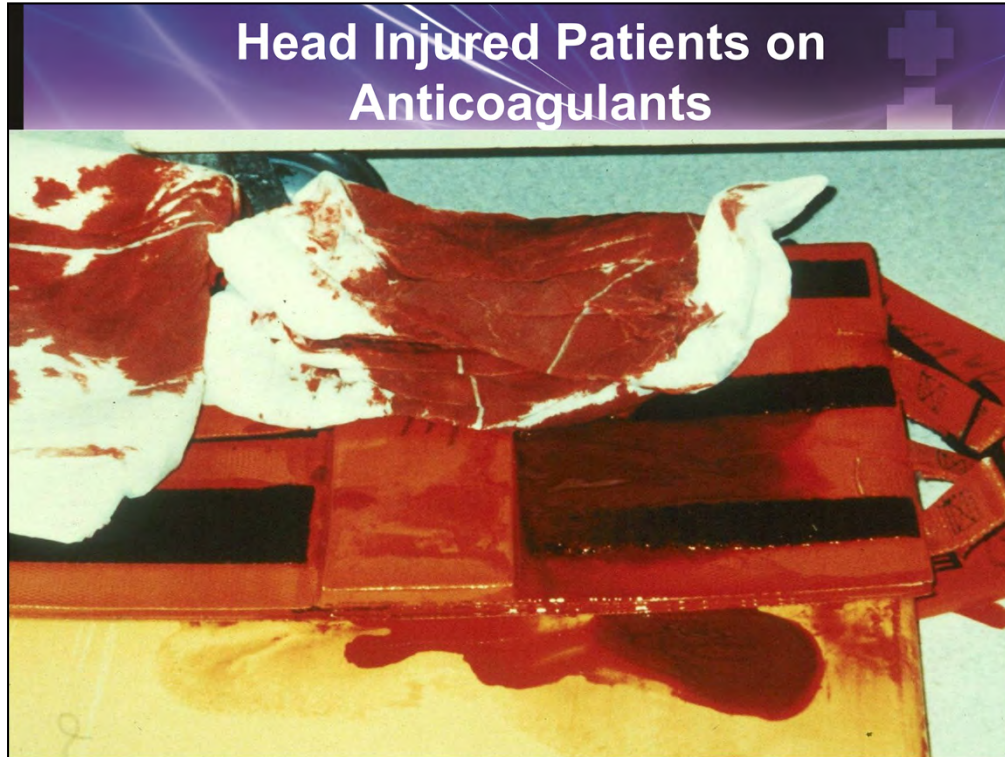


## Unique Situations Impacting Care

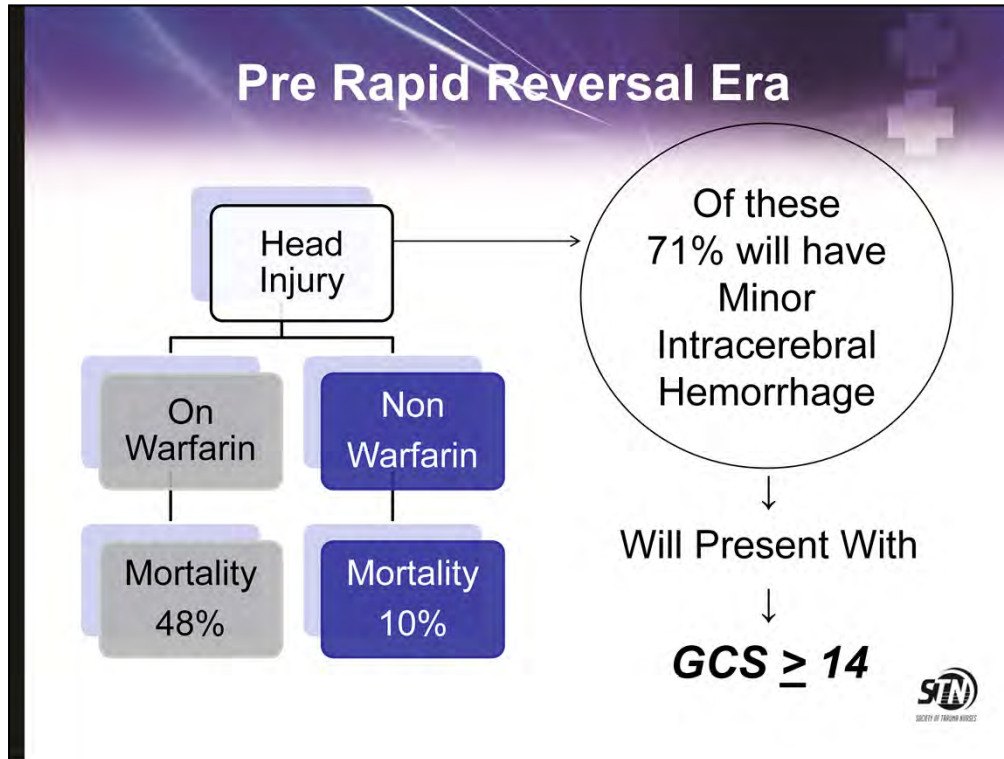
- Head Injury:
  - On anticoagulants/platelet inhibitors
- C Spine Injury:
  - Diagnostic & treatment challenges
- Blunt Chest Injury:
  - Pain control



These 3 situations create major challenges for trauma centers and are increasingly present in the elderly trauma population.

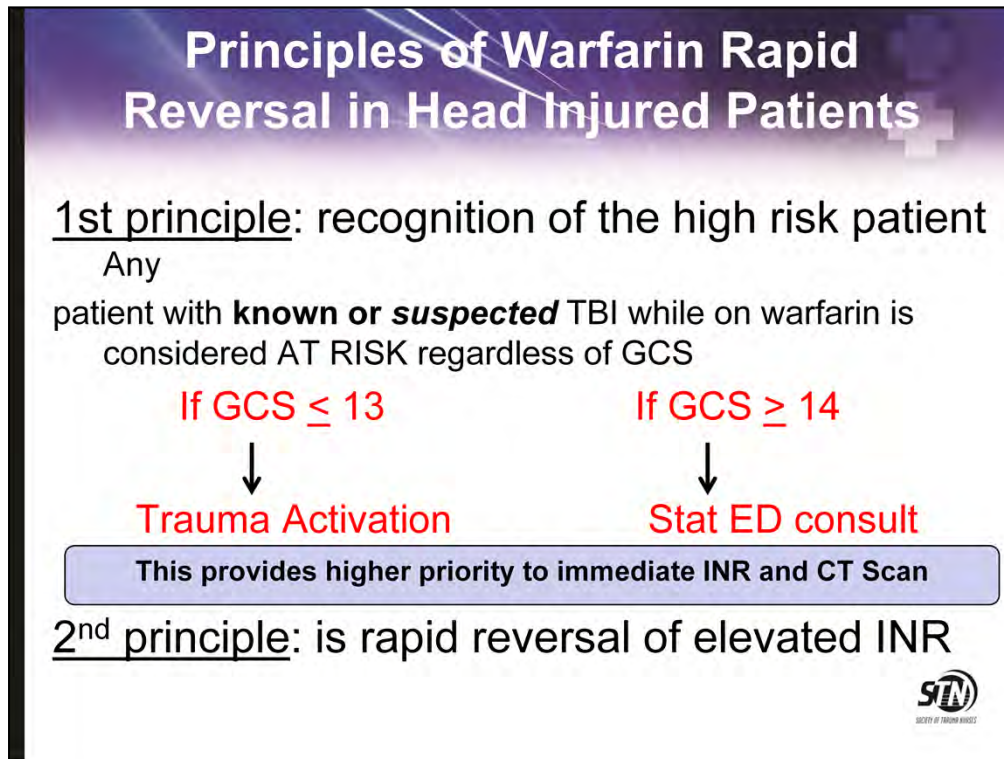


- This picture was taken of a back board that had just been used to transport an elderly patient with a scalp laceration who was on warfarin (Coumadin) and had an INR of 3.
- The medics were also reminded that a pressure dressing does not take the place of direct pressure.
- It is not unusual for an elderly patient to arrive at the Emergency Department Triage desk complaining of a fall, a syncopal episode, dizziness, headache.
- The spouse may tell you that the patient is “acting funny”, “not themselves”.
- In each of these cases specifically trying to determine if the patient fell, not just this day but in the past 7-10 days or so and if the patient takes any anticoagulant or antiplatelet medication is vitally important.



There have been many studies in the correlation of mortality from traumatic intracranial hemorrhage and warfarin.

- Increased mortality is seen at age 60 years in patients who sustained a TBI in a MVC, despite no difference in Injury Severity Score and a decrease in crash severity.
- Patients on anticoagulation or antiplatelet therapy suffering minor head trauma, with GCS 15, have a high incidence of intracranial hemorrhage.
- The frequency of positive head CTs in one study was 41 of 141 (29%).
- LOC was a statistically significant predictor of a positive CT result.
- Positive head CTs almost always led to a change in clinical management.
- There was no statistically significant difference between antiplatelet versus anticoagulant usage and a positive CT result.



### Caution

- Neither the initial GCS nor INR in anticoagulated trauma patients reliably identifies patients with ICH.
- Rapid confirmation of ICH with expedited head CT scan combined with prompt reversal of warfarin anticoagulation with fresh frozen plasma decreases ICH progression and reduces mortality


### Triage Process

- We must recognize that **any** patient with a known *or suspected* TBI who was taking warfarin is at risk.
- If the initial GCS was <14, then a full trauma team activation is called. This gives the patient priority lab processing and immediate access to the CT scan
- If the GCS is 14 or 15, implement some type of Stat ED consult or develop some kind of a “Code RED”, ensuring that an ED physician sees the patient immediately.

**Bottom line: Patients with any head trauma and an elevated INR are a walking time bomb. They need prompt assessment and reversal of their anticoagulation if indicated.**

## Reversal Products

- **Vitamin K:**
  - Used to increase the biological activity of clotting factors, but often takes hours to achieve
- **Plasma:**
  - Access to thawed plasma ideal
  - Frozen plasma requires thaw time and delay
  - Risk of fluid overload: multiple plasma units may be required to normalize higher INR's
  - Half-life FFP < warfarin so continue checking INR q4hr



- A growing number of adults, usually elderly, are taking **Coumadin** (warfarin) to manage chronic medical conditions or deep venous thrombosis.
  - While warfarin is a very useful drug for these problems, it is notoriously difficult to maintain tight control of INR.
  - If an individual on warfarin is involved in a fall or vehicular crash, bleeding complications can become life-threatening.
  - Studies have shown that mortality more than doubles in elderly patients who are admitted awake after just falling from standing.
- The key is to rapidly reverse an elevated INR.

## Reversal Products

### Prothrombin Complex Concentrate (PCC)

- Promising new product from Europe
- Contains:
  - Vitamin K-dependent coagulation factors II, VII, IX, and X
- Advantages over FFP:
  - Faster correction
  - no volume overload
  - more complete correction
- Research ongoing
- Currently off label product
- Costly



**PCC has been used primarily in Europe and is emerging in the US**


- PCC appears to be a safe and effective alternative to FFP and provides rapid reversal of INR in patients on vitamin K antagonist therapy.
- These agents may be advantageous compared to FFP in patients with volume restrictions.

**More Research is Needed:**

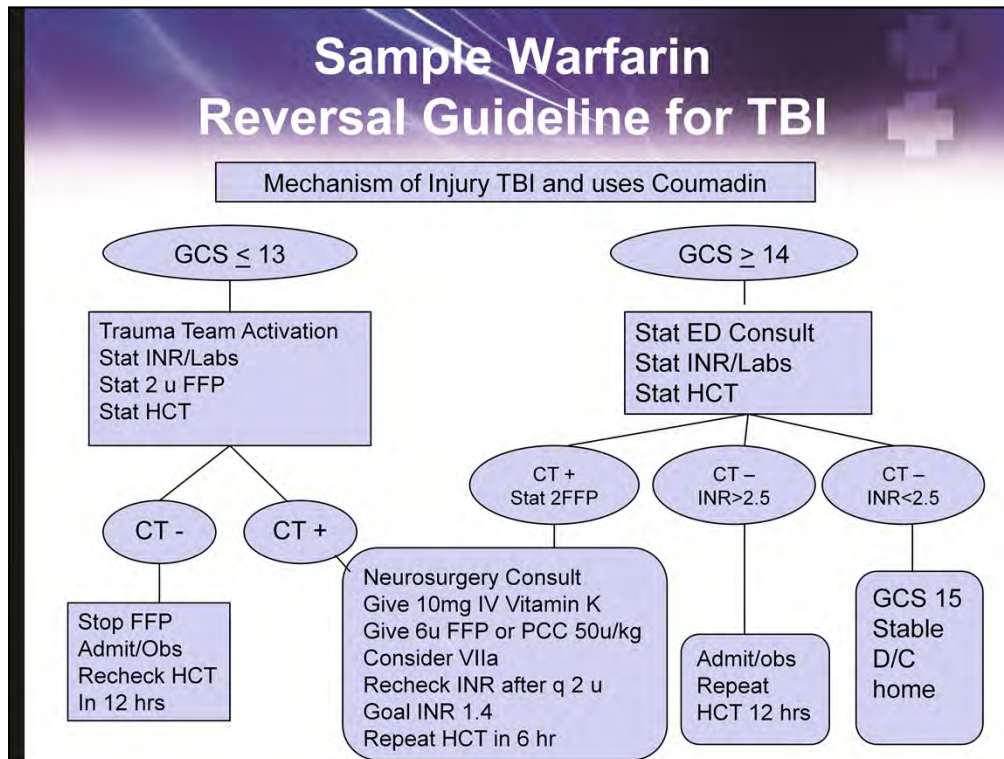
- Comparative trials are needed to compare the various PCC products, FFP, and recombinant factor VIIa with regard to clinically significant outcomes such as hemostatic effect.
- In those studies in which PCCs were compared with FFP, PCCs were found more effective in shortening the time to INR correction and were associated with a low risk of thrombotic adverse events.

## Reversal Products

- **Activated Factor VII (Novo-Seven)**
  - Has been used successfully to aid rapid reversal
  - Wt <100 Kg Give 1 mg
  - Wt >100 Kg Give 2 mg
  - This is an off label use and physicians must weight the risks and benefits
  - It is very costly at approximately \$7000/vial
  - Short 3 hr half life may require multiple doses
  - More recently has fallen out of favor due to cost and associated embolic events



- Factor VIIa provides a cost-efficient option to effectively correct coagulopathy in patients with traumatic brain injury undergoing emergent craniotomy.
- In addition, the use of rFVIIa is associated with decreased transfusion of PRBC and plasma and decreased transfusion-related hospital costs in this population.
  
- Reversal of warfarin using FFP and Vitamin K takes time and may delay neurosurgical procedures, thus the reason for using recombinant Factor VIIa.
  
- Relative contraindications to Factor VIIa administration include patients with:
  - DVT
  - PE
  - MI
  - CVAWithin last 30 days prior to event or who are pregnant



- First, recognize that **any** patient with a known *or suspected* TBI who was taking warfarin is at risk.
- If the initial GCS was <14, then a full trauma team activation is called. This gives the patient priority lab processing and immediate access to the CT scan. In addition, 2 units of thawed plasma are administered immediately while in the resuscitation room. **The FFP is given no matter what the INR.**
- If the head CT is negative, plasma is stopped.
- For patients with a GCS of 14 or 15, a “Code RED” or stat ED consult is called, ensuring that an ED physician sees the patient immediately. A point of care INR is drawn and the patient is sent for stat head CT. If the head CT is negative with INR>2.5, the patient is admitted for observation and a repeat head CT is obtained 12 hours later. **Caution: We have seen patients develop delayed hemorrhage when they have high INR.**
- Apply a restrictive set of criteria to determine if a patient may go home from the ED, which causes us to admit most for observation. And if they do have a positive CT, consult NS and begin Vit K and FFP or PCC infusions. Also may consider VII.



## Clopidogrel (Plavix)

- **Action:**
  - Inhibits platelet aggregation
  - This action is irreversible
  - Long half life
- **To counteract:**
  - Repeated Platelets required
  - But the infused platelets are inhibited by remaining drug
  - Requires repeated platelets to get meaningful clot formation





**Clopidogrel (Plavix)** was the seventh leading drug in terms of US sales with \$2.23 billion spent on this in 2006.

•It is also ranked as having the “most motivating pharmaceutical advertisement” directed toward consumers in 2005.

•TBI patients on clopidogrel may have increased long-term disability and fatal consequences when compared with patients who are not on these drugs or on other anticoagulants.

•Patients on clopidogrel should be advised of safety when engaging in potentially dangerous activities to avoid the consequences of TBI.

•Repeated administration of platelets may reverse the disaggregation caused by the clopidogrel

## Dabigatran (Pradaxa)

- Oral direct thrombin inhibitor
- Half life is 12-17 hours
- No reversal agent!  
FFP, PPC, Platelets don't work
- Dialysis will remove 60% of drug in 2-3 hours



- Pradaxa is a real problem in trauma.
- **There is no antidote to Pradaxa.**
- It can be dialyzed (protein binding is low), with the removal of about 60% of drug over 2 to 3 hours; however, data supporting this approach are limited.”
- Some have suggest that if the last dose of the drug had been taken within 2 hours to consider activated charcoal administration as well as consideration for dialysis.


## Cervical Spine Injuries

Prevalence in the elderly:

- 2.6% to 4.7%

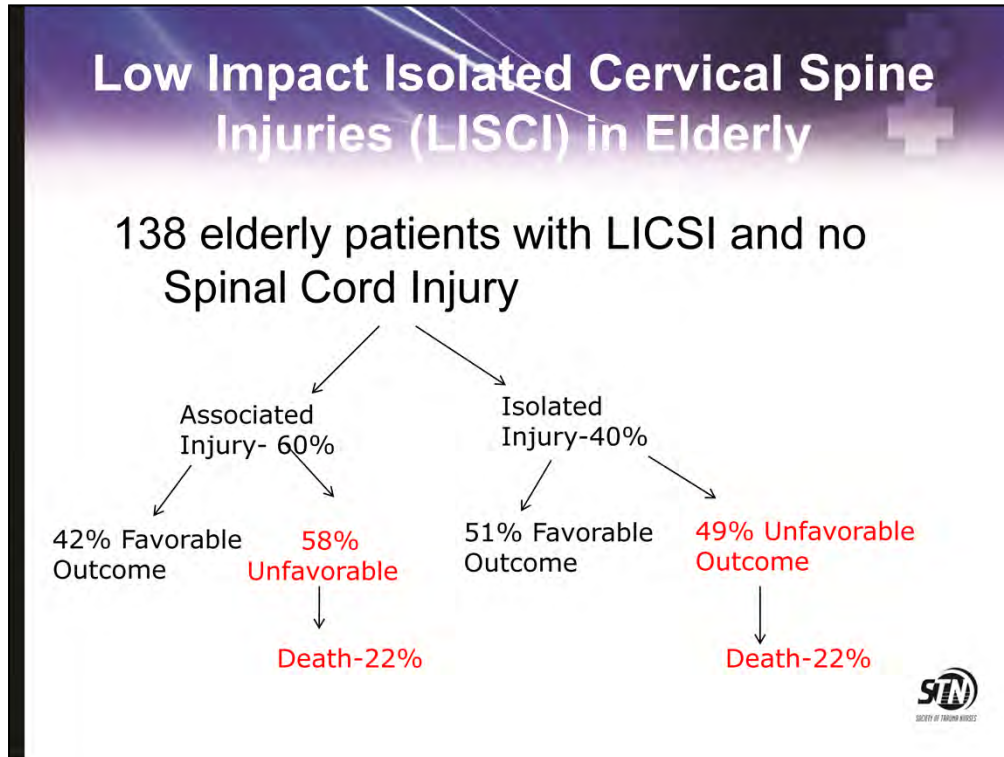
Low impact mechanisms such as falls from standing account for 50% of these cervical injuries.

Cervical Vertebrae [C2-T1], Assembled  
Right Lateral View



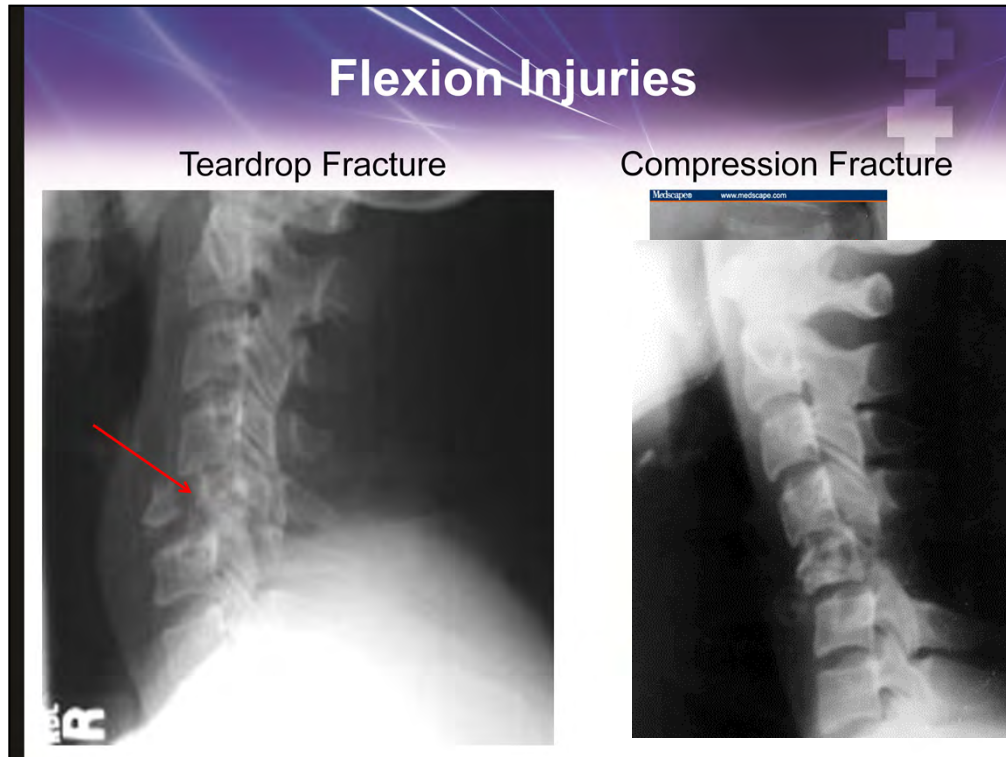
*F. Netter M.D.*  
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- Spinal cord injuries in older patients are becoming more prevalent.
- Mechanisms of injury frequently involve low velocity falls, as opposed to the high velocity traumas responsible for most other spinal cord injuries.
- Age-related comorbidities such as cervical spondylosis, osteoporosis, osteoarthritis, and neuromuscular disorders play into the pathophysiology of injury in this population.
- The mortality rate in this patient group is much greater than in younger patients and should be taken into account when aggressive interventions are considered and in counseling families regarding prognosis.



- This is a result from a study performed at Cleveland Metro Health, a Level 1 trauma center in Ohio. The unfavorable outcomes included death, transfer to a skilled nursing facility or a long term acute care facility. Favorable was discharge home or to acute inpatient rehab.

- Note the similarity in unfavorable outcome whether isolated injury versus multiple injuries
- The results strongly indicate that a low impact isolated injury has slightly less unfavorable outcome than a cervical spine injury with associated injuries (including spinal cord injury), however the mortality rate is the same.



**Flexion injuries** may occur when there is a fall and the back of the head strikes a step, a coffee table, a counter top.

**Flexion teardrop fracture** occurs when flexion of the spine, along with vertical axial compression, causes a fracture of the anteroinferior aspect of the vertebral body. This fragment is displaced anteriorly and resembles a teardrop

**Compression (or wedge) fracture** is a fracture of the vertebral body caused by squeezing of the bones when downward compressive force is transmitted to lower levels in the cervical spine, the body of the cervical vertebra. Depending on the force it can also shatter outward, causing a burst fracture. This fracture involves disruption of the anterior and middle columns, with a variable degree of posterior protrusion of the latter.



Another Flexion injury is **subluxation** as seen in slide, or unilateral or bilateral facet injuries


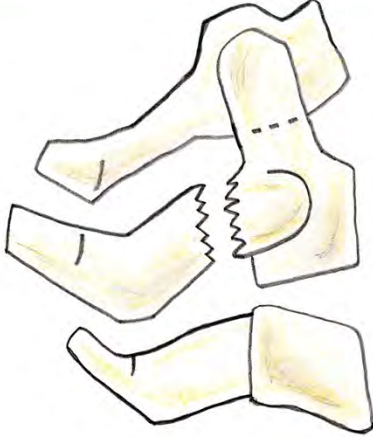
**Anterior subluxation** in the cervical spine occurs when posterior ligamentous complexes rupture.

- Anterior subluxation is rarely associated with neurologic sequelae.
- Nevertheless, most authorities approach this injury as if it were potentially unstable because of the significant displacement that can occur with flexion, and very rare cases have associated neurologic deficit.

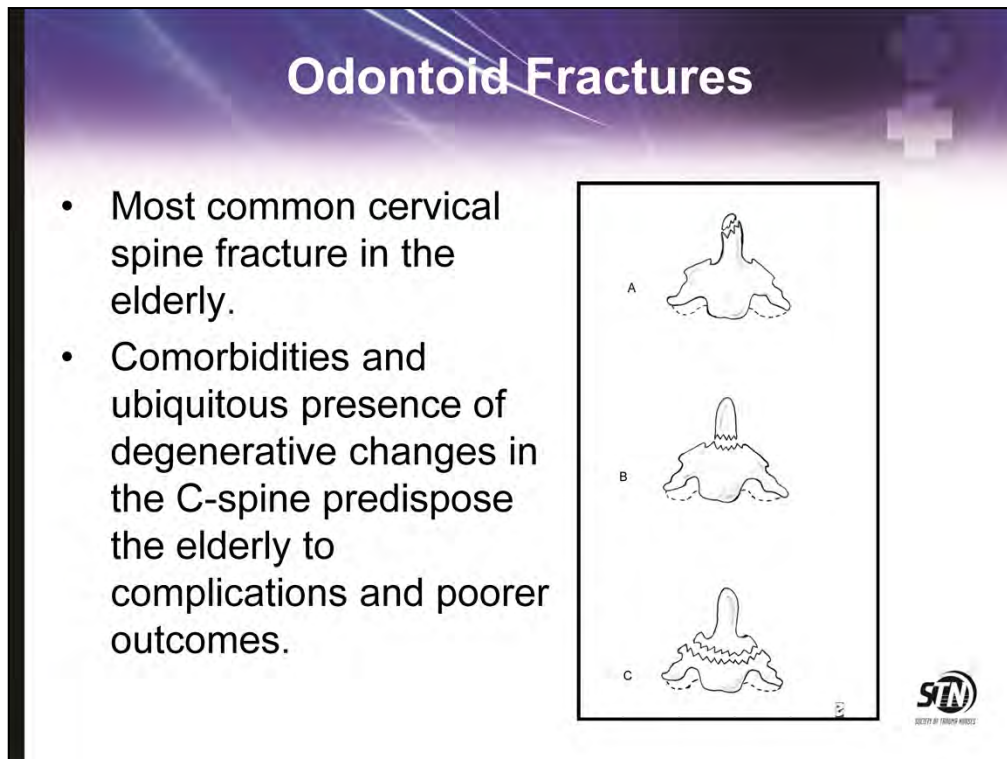
## Extension Injuries

### Hangman Fracture

- Name derived from the typical fracture that occurs with hanging
- Commonly caused by motor vehicle collisions and entails bilateral fractures through the pedicles of C2 due to hyperextension.



The image above is called a hangman's fracture and is a type of fracture caused by hyperextension.



**Odontoid Fractures:** A fracture caused by sudden forward and backward movement of the head with respect to the trunk

**A. Type I odontoid fracture** is an avulsion of the tip of the dens

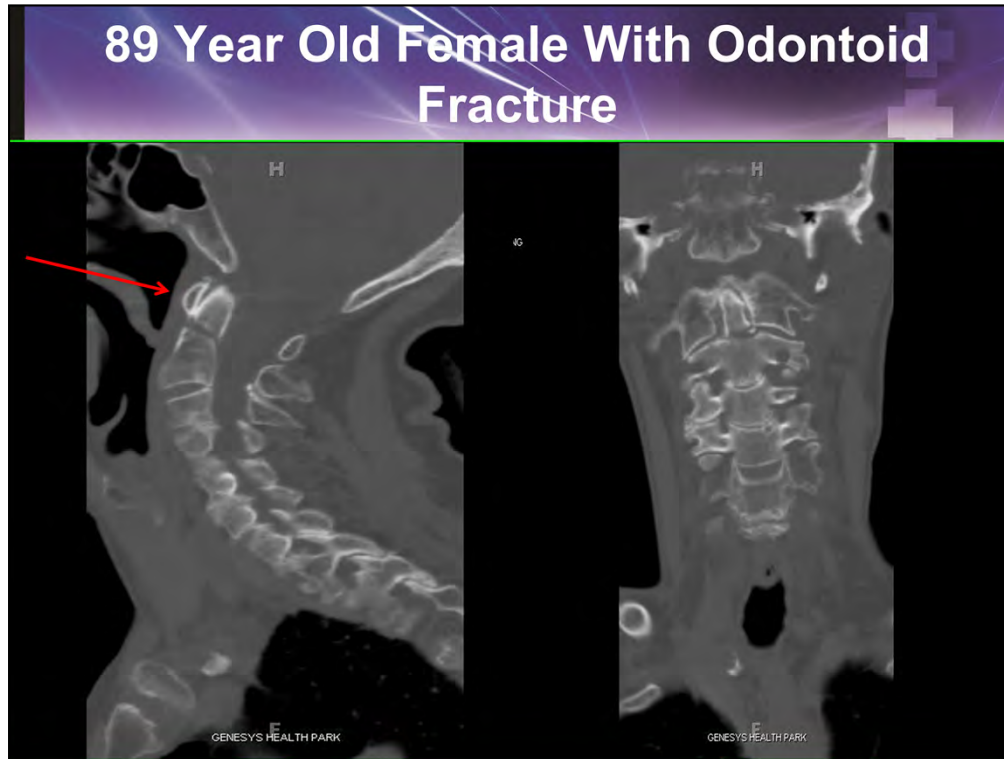
**B. Type II odontoid fractures** occur at the base of the dens and are the most common odontoid fractures. This type is associated with a high prevalence of nonunion due to the limited vascular supply and small area of cancellous bone.

**C. Type III odontoid fracture** occurs when the fracture line extends into the body of the axis. Nonunion is not a major problem with these injuries because of a good blood supply and the greater amount of cancellous bone.

\*Several studies have documented increased morbidity and mortality among geriatric patients sustaining odontoid fractures. The nonunion rate in this population has been reported to be as high as 85% (range, 20%–85%) and the mortality rate has approached 60% (range, 10%–57.1%)

Moreover, the choice of management (operative vs. nonoperative, halo-vest immobilization vs. Cervical orthosis) has been postulated to influence mortality





The images are of an 89 year old woman who slipped, fell forward hitting chin on coffee table. She walks into triage with her daughter.

As you can see, there is significant kyphosis from compression fractures.

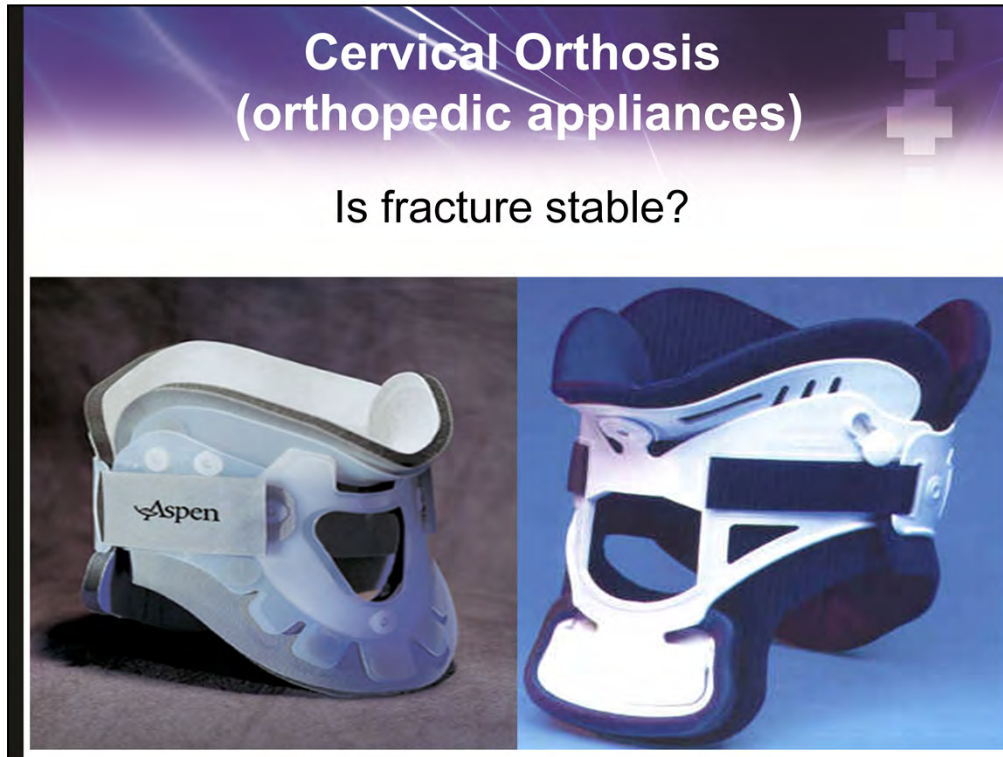
Is she a candidate for a hard collar, a Halo vest, surgical fixation?

The next slides will give you the information you need to answer this question.



This is an example of **nail fixation of an odontoid fracture**.

- While there is no Class one evidence that surgical fixation is the treatment of choice for odontoid fractures in the elderly
- There is evidence that mortality rates are less.



**Fit Concerns**

- A stable fracture generally requires only a hard collar, however it will be very difficult to find a collar that fits her appropriately.

**Complications of collars:**

- The most common adverse complication is skin breakdown
- Incidence of skin breakdown as high as 8% of all trauma in some centers
- Days in the cervical collar is a significant predictor of skin breakdown, along with presence of edema.

How about a Halo Vest?

## Halo Vest

- Designed to provide immobilization of cervical and upper thoracic spine
- Associated with increased complications and death in the elderly



•The halo vest, in particular, has been associated with an increased risk of complications and death in elderly patients.

•**Reported complication rates** of halo use in the elderly:

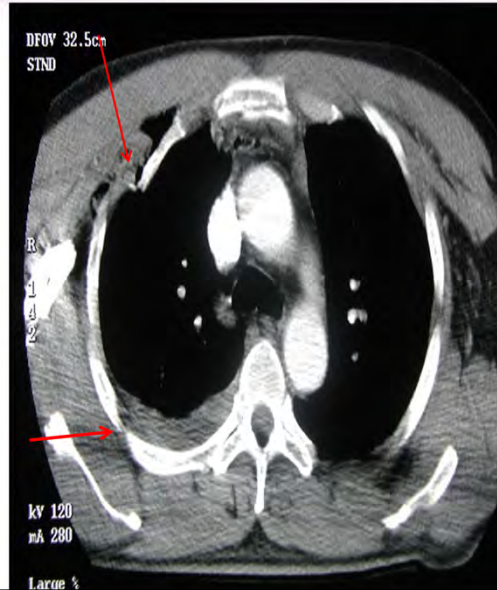
- pneumonia (34%)
- cardiac arrest (26%)
- mortality (42%)

•These complications may be the result of :

- the difficulty in swallowing
- the immobility that often results
- the issues of balance
- the presence of pre existing dementia

## Rib Fractures

- Most common injury in elderly blunt chest trauma
- Each additional rib fracture increases the odds:
  - Pneumonia by 27%
  - Dying by 19%
- Increased ventilator days
- Increased ICU days



- Rib fractures are a significant cause of pain and disability in patients with isolated thoracic injury and in patients with associated extrathoracic injuries.
  - Developing new therapies to accelerate pain relief and healing would substantially improve the outcome of patients with rib fractures.
- Note the rib fractures on this CT image.**

## Intervention for Isolated Rib Fractures



### In nonelderly patient

- Isolated rib fx with minor mechanism-discharge
- Isolated rib fx with major mechanism-observe

### Isolated rib fx in elderly

- Trauma consultation
- Observe or admit
- Pain control
- Incentive spirometry



•Pneumonia is significantly associated with mortality in the elderly patient with isolated rib fractures.

•Aggressive attempts to relieve pain, prevent atelectasis, improve functional residual capacity and vital capacity, and improve the ability to clear secretions .

•Image is a type of Incentive Spirometer.

## Guidelines for Acute Pain Management

- Thorough assessment of pain
  - History and Physical
  - Self report using appropriate scale for individual
- Schedule:
  - Opioid & NSAID's pain meds around the clock
- Select least invasive and safest route
- Multi-modality therapy now the norm
  - Options: PCA, epidural, & peripheral nerve block




### **Multi-modality**

Multi-modality therapy for multiple rib fracture-related pain control has become increasingly common in recent years with the introduction of intravenous (IV) NSAIDs and regional analgesia using continuous bupivacaine infusions, both of which have been shown to decrease opiate requirements and their related side effects.

## Pain Management

<h3>Opioids</h3> <ul style="list-style-type: none"> <li>• Multiple Side Effects:             <ul style="list-style-type: none"> <li>• Respiratory Depression</li> <li>• Delirium</li> <li>• Constipation</li> </ul> </li> <li>• Avoid use of:             <ul style="list-style-type: none"> <li>• Methadone</li> <li>• Propoxyphene</li> <li>• Meperidine</li> <li>• Due to toxicity of metabolites</li> </ul> </li> </ul>	<h3>Non Steroidal Anti-Inflammatory Drugs (NSAIDs):</h3> <ul style="list-style-type: none"> <li>• <b>Ibuprofen</b> 800mg IV q6 hrs or</li> <li>• <b>Toradol</b> 15mg IV q6 hrs</li> <li>• Limit IV-NSAID therapy to &lt; 5 days</li> </ul> <h3>Contraindications to NSAID's:</h3> <ul style="list-style-type: none"> <li>• Allergy to aspirin or any NSAID</li> <li>• Asthma, Urticaria, Allergic reaction</li> <li>• On anticoagulants</li> <li>• Peptic ulcer disease</li> </ul>
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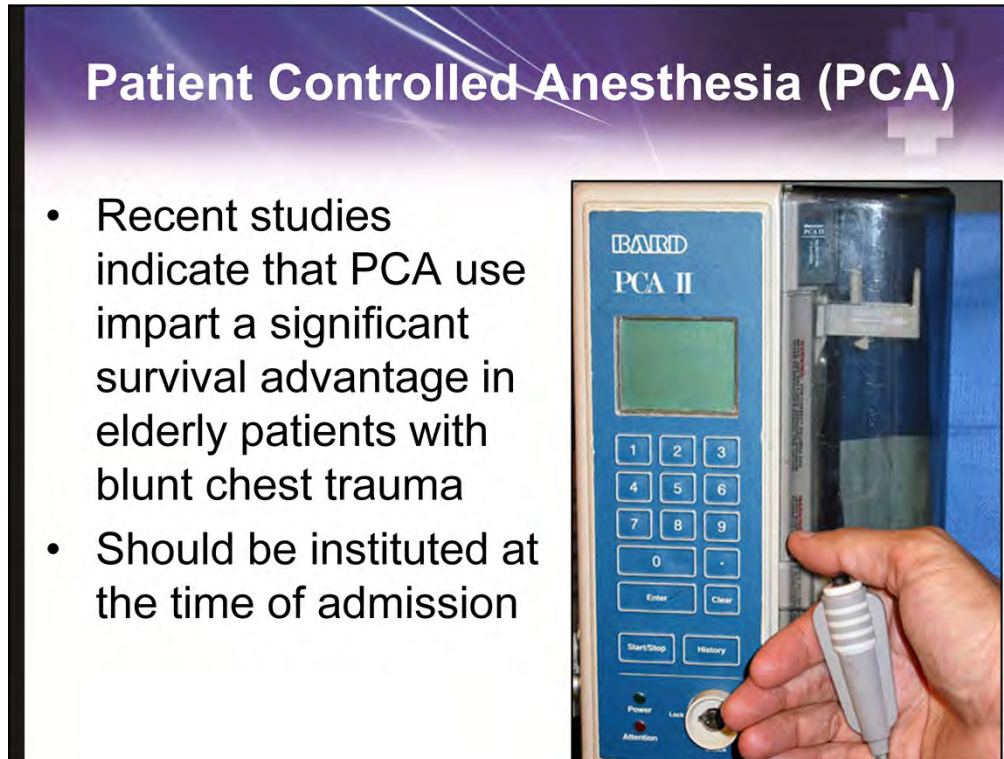


### Opioid Side Effects

- Of all the unwanted effects of the opioids, the most difficult to deal with is that of constipation.
- An aggressive approach using bowel stimulating laxatives is critical in order to prevent this problem

• Pain management is essential and in addition to opioids, tylenol and NSAIDS (if no contraindications), regional anesthesia/analgesia can provide excellent and prolonged postoperative analgesia that provides quicker and more comfortable patient mobility, decreases opioid requirements, facilitates participation in physical therapy, and expedites return-to-normal activities.





**Patient controlled analgesia (PCA)** is a method of pain control that gives the patient the power to control their pain.


- In PCA, a computerized pump called the patient controlled analgesia pump -- that contains a syringe of pain medication as prescribed by a doctor is connected directly to a patient's intravenous (IV) line.

- In some cases, the pump is set to deliver a small, constant flow of pain medication. Additional doses of medication can be self-administered as needed by the having the patient press a button. Other times, a patient can control when he or she receives pain medication and does not receive a constant flow.

The pump can be used whenever the patient is feeling pain. However, patients should not press the button on the machine if they are feeling too sleepy. The more alert the patient is, the more likely he or she is to participate in a therapy program to aid and possibly shorten recovery. Once the acute pain from surgery is controlled, the patient will be switched to pills for pain relief.

## Epidural Analgesia EAST Guidelines

<b>Level I Evidence</b>	<b>Level II Evidence</b>
1. Epidural analgesia: <ul style="list-style-type: none"> <li>• Optimal modality for blunt chest wall injury</li> <li>• Preferred for severe blunt thoracic trauma</li> </ul>	1. Use Epidural analgesia: <ul style="list-style-type: none"> <li>Age <math>\geq</math> 65 with <math>\geq</math> 4 rib fxs</li> <li>Unless contraindicated</li> </ul> 2. Consider epidural analgesia: <ul style="list-style-type: none"> <li>Ages <math>\leq</math> 65 with <math>&gt;</math> 4 rib fxs</li> <li>or</li> <li>Ages <math>\geq</math> 65 with lesser injury</li> </ul>



•These Guidelines were published in the Journal of Trauma by Eastern Association for the Surgery of Trauma (EAST) in 2005.

•However in a meta analysis published in 2009, Carrier et al in Quebec concluded that “

**“No significant benefit of epidural analgesia on mortality, ICU and hospital LOS was observed compared to other analgesic modalities in adult patients with traumatic rib fractures.**

•However, there may be a benefit on the duration of mechanical ventilation with the use of thoracic epidural analgesia with local anesthetics.

•Further research is required to evaluate the benefits and harms of epidural analgesia in this population before being considered as a standard of care therapy”.

## Continuous Peripheral Nerve Block

- Superior pain relief than narcotics alone
- management
- Used for pain control in rib fractures



- May be used for pain management during transfer to distant trauma centers or while awaiting surgical repair.



Documented benefits appear to be dependent on successfully improving analgesia, and include decreasing baseline/breakthrough/dynamic pain, supplemental analgesic requirements, opioid-related side effects, and sleep disturbances.

In some cases, patient satisfaction and ambulation/functioning may be improved; an accelerated resumption of passive joint range-of-motion realized; and the time until discharge readiness as well as actual discharge from the hospital or rehabilitation center achieved. Lastly, postoperative joint inflammation and inflammatory markers may be decreased.

Nearly all benefits occur during the infusion itself, but several randomized controlled trials suggest that in some situations there are prolonged benefits after catheter removal as well.

Major risks including clinically relevant infection and nerve injury are relatively rare.

## Operative Rib Fixation


Limited number of surgeons perform surgical rib fixation

Benefits:

- Faster return lung function
- Fewer complications
- Shorter vent/ICU/hosp LOS

Indicated:


- Flail chest and respiratory failure without pulmonary contusion (early fixation)
- Symptomatic mal- and non-unions (later fixation)
  
- Further research needed



- Surgical management of patients with severe flail chest is at present controversial
- However, surgical stabilization is strongly indicated in specific clinical situations.
- The effectiveness and the ideal timing of chest wall stabilization in patients on mechanical ventilation is related to the degree of the pulmonary parenchymal damage.
- The presence of extensive pulmonary contusion is a relative contraindication to surgical stabilization.
- Patients with mild or no pulmonary contusions, early surgical stabilization (within few days of internal pneumatic stabilization) may result in shorter intensive care unit stay with lower morbidity and prevention of pulmonary restrictive complications resulting in working incapacity .
- Another indication for surgical stabilization is the presence of an extensive antero-lateral flail chest in a young patient even in the absence of severe respiratory failure.
- Image is of internal fixation of a rib.**

## Case Study


- 76 year old male, fell 6-8 feet from ladder while cleaning leaves from gutters
- Witnessed by neighbor who found him lying on back, moaning in pain



Using this case study, think about what special considerations due to this patient's age and injuries will be necessary as the plan of care is developed.

## PreHospital

- He did not recognize his neighbor who related that he is a widower with out of state children
- BP 180/75
- Pulse 120 and irregular
- Respirations 28 with wheezing
- Pulse ox 89% prior to application of O2.
- GCS 14-15



You get this information via pre hospital radio report.

Will you activate your trauma team?

What level?

## ED Physical Exam


- Left frontal contusion, odor of alcohol
- Tenderness to palpation left lateral chest with crepitus, equal breath sounds and bilateral wheezing, heart sounds distant



What can cause an odor of alcohol?  
How about wheezing?  
Are distant heart sounds significant?  
What are potential injuries so far?

## Physical Exam

- Abd ok, pelvis stable, no blood at the meatus and good rectal tone
  
- Pain, swelling and ecchymosis left wrist, upper arm, shoulder and left proximal thigh with shortening and internal rotation



Now what are the injuries?


Potentially a head injury, fractured ribs, maybe pulmonary contusion along with fractured hip and possibly fractures of radius, ulna humerus.

Three systems and we still don't know his health history (co-morbidities)



## Vital Signs


- BP 118/60
- P120 irregular
- R 28 with audible wheezing
- T 36 c (96.8f)
- Pulse ox 92% on 100% O<sub>2</sub>



Is the drop in BP significant? He is still tachycardic.  
What is the significance of the pulse oximetry result?

## Neuro Status


- PERLA, oriented only to person, speech slurred, obeys inconsistently
- GCS 13-14



Why is speech slurred? Did he have a stroke and then fall? Is he impaired by alcohol? Is an intracranial bleed expanding?

## Additional Info

- He is on Glucophage(Metformin)
- Metoprolol (Lopressor)
- Warfarin (Coumadin)
- Alupent (metaproterinol) inhaler tucked in a half-empty cigarette pack



A drug list is found in his wallet.

What are his comorbidities?

Diabetes? Does this explain the alcohol breath?


High Blood Pressure? Atrial Fibrillation

Why the Warfarin?

Does he have COPD?

## Labs

- ABG: 7.30 50 180 19 94% NRB
- H&H: 33.5 11.2
- WBC: 12,500
- LYTES: OK
- GLUCOSE: 275
- BAC: 0.125
- INR 1.2



What do the ABS's tell us?

The H&H?

How about the WBC? The Glucose and the INR?

And of course the BAC.

Is there a component of metabolic acidosis?

Does he have a urinary tract infection, or is the WBC related to the inflammatory response?


Is he taking his Coumadin?

We now know he drinks

J35

## X-rays

- Rib fractures 7,8,9
- Wide mediastinum, torturous aorta
- C-spine multiple degenerative changes difficult to interpret
- Comminuted intratrochanteric femur fracture and Colles fracture
- CT head, neck, and abdomen ok



What are potential complications for this patient?

- Pneumonia
- Atelectasis
- Alcohol withdrawal
- DVT
- Sepsis from pre existing UTI
- Skin Breakdown
- Prolonged length of stay

What are some of the coordination of care issues?

- Communication with out of town family
- Discharge planning
  - Acute vs subacute rehab
  - Potential transfer to be near children

## Summary

- The elderly are not able to compensate as quickly or as efficiently as a younger adult.
- Co-morbidities in the elderly trauma patient can have deleterious affects on their outcome.
- They will be us.....



The image is a group of members of a local Senior Citizen Center.