It's not just the anticoagulation...or is it?
Understanding and managing the risks in elderly trauma patients
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2014 Duke Trauma Conference
March 20, 2014

Objectives
1. To understand therapeutic coagulopathy and its impact on the geriatric trauma patient
2. To review the coagulation pathway in this context
3. Talk about some of the new anticoagulation drugs being used
4. To define what is meant by geriatric trauma
5. Examine how other co-morbidities affect short term and long term outcomes in this population

Elderly patients and anticoagulation
- A large percentage of patients on anticoagulant and antiplatelet therapy are elderly
- Not only does this increase the risk of complications from trauma, it also acts as a marker of physiologic pathology

Anti-platelet and anticoagulation therapy--indications
1. Coronary artery disease
   A. Native disease
   B. Patients with coronary stents
2. Atrial fibrillation
3. Cerebrovascular disease
4. Thromboembolic venous disease
5. Valve replacement

Anti-platelet therapy
- Aspirin
  - Inhibits platelet aggregation through acetylation of cyclooxygenase
  - Effect lasts 5 to 7 days
- Clopidogrel (Plavix)
  - Reversibly binds to receptors on platelets to inhibit platelet aggregation
  - Effect lasts 3 to 10 days
- Cilostazol (Pletal)
  - Reversibly inhibits platelet aggregation
  - Effect lasts 12-14 hours

Clopidogrel and trauma
- In a recent study *Joseph B et.al* prospectively showed that patients on clopidogrel had more progression on repeat head CT than patients not on the drug (65% vs 18%), p<.01
- Patients also had an increased rate of neurosurgical intervention (5% vs 1%), p<.02
- The mean age of the patients in the study was 70.5, and two thirds were male
- The mean age of the patients getting CP was about 2 years older than those not, but not statistically different
- About 22% of patients were from GLFs
- Median ISS 18 for CP group and 16 for no CP
- There was a trend towards higher mortality (21% vs 11%), but not statistically significant (p=0.08)

*J Trauma Acute Care Surg, 76(3):2014, pp. 817-820*

So what does this all mean?
- This study was focused on TBI patients and does not translate to all trauma victims
- Modest affect on mortality probably because death not always from the TBI
- However, TBI is a major contributor to morbidity and mortality in this group of patients
- This type of therapy is a marker for the elderly (>65)
- Predominant mechanism common to this patient population (falls in 82%)
- Platelet transfusion did not seem to have any affect on outcomes
Anticoagulants and trauma

- Anticoagulation therapy significantly impacts outcomes in trauma.
- Much of this effect is through TBI.
- Other organ systems injured causing hemorrhage can or should be controlled surgically, or there is more time for reversal.
- In every case of an anticoagulated trauma patient, the risk of bleeding has to be weighed against the risk of reversing the therapeutic coagulopathy.

Initial scans can be misleading

- Several reports of delayed intracranial hemorrhage in anticoagulated patients with minor traumatic brain injury.

In this case report the patient was a young male without anticoagulation.

Transfer to Level II trauma center

- The patient was accepted for transfer to Level II center.
- Took about 4 hours from the time of diagnosis to transfer.
- Patient given 4 mg of morphine prior to transport.
- Nothing was given to the patient to reverse the coumadin.

At Level II trauma center

- Patient arrived with a GCS 6.
- Thought initially due to morphine given for transportation.
- Did not improve after reversal of sedation.
- Because of significant change in mental status the airway was secured with an endotracheal tube and the patient was sent immediately for a repeat CT scan of the head.

Case #1

- Head injury in patient on coumadin.
  - 76 y.o. male with GLF from nursing home.
  - Multiple medical problems including:
    - CAD w/ CABG/stents
    - Atrial fibrillation
    - DM
    - Obesity
    - Hypertension
    - Chronic UTI with urinary retention
    - Hypolipidemia

- Head injury and coumadin.
  - The patient was debilitated from a recent cholecystectomy with postoperative biliary leak.
  - Presented to outside hospital with PT/INR of 28.7/2.69.
  - Vital signs were normal.
  - GCS 15.
  - CT scan of the head without contrast done at outside hospital.
After explaining the very poor prognosis for this patient to his family, with or without surgery, he was taken to the operating room for a craniotomy by the neurosurgeon on call.

The injury was deemed non-survivable.

The patient was brain dead.

Several concerns about this case, but the most compelling was the failure to reverse the coumadin fast enough to prevent herniation.

Although the patient was on coumadin for medical reasons, if surgery is required or the patient has significant bleeding from trauma it needs to be rapidly reversed in order improve survival and decrease morbidity.

There was no process for reversing anticoagulation in patients with life-threatening bleeding, particularly those with intracranial hemorrhage.

Based on evidence out of EAST, AAST and a literature review it was determined that better outcomes could be expected if a system was developed to address anticoagulation reversal quickly and effectively.

This protocol was developed to reverse coumadin in anticoagulated trauma patients at risk for life-threatening bleeding.

It evolved into a systemwide pharmacology policy and protocol for any hospitalized patient on coumadin.

Antiplatelet medications and new anticoagulants were also added to the protocol.

Most commonly used oral anticoagulant.

Inhibits the synthesis of vitamin K dependent clotting factors II, VII, IX, and X.

Also inhibits anticoagulant proteins C and S.

Effect is measured and regulated by the Prothrombin time (PT) (international normalized ratio) INR.

PT/INR must be regulated, making this one of the drawbacks in using it.

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**Anticoagulants**

- Heparin sodium
  - Works at multiple levels in the coagulation system
  - Combines with anti-thrombin III, then inactivates Factor X and prothrombin conversion to thrombin
  - Effect lasts 3-4 hours
  - Can be neutralized by protamine sulfate
  - Enoxaparin (Lovenox)
    - Reversible anti-Factor Xa and thrombin inhibition
    - Effect lasts about 8 hours
    - Can also be partially neutralized by protamine

- Fondaparinux sodium (Arixtra)
  - Works like heparin by binding to antithrombin III and neutralizes Factor Xa and subsequently thrombin formation
  - Effect lasts about 24 hours

**Anticoagulants (cont’d)**

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- Dabigatran (Pradaxa)
  - Direct thrombin inhibitor
  - Effect lasts about 24 hours
  - No direct reversal or antidote
  - Does not require laboratory regulation

**Other Factor Xa inhibitors**

- Betrixaban
- Darezaban
- Edoxaban (Savaysa)
- Omazaban
- All these commonly do not have a current reversal or antidote

**Andexanet alfa (PRT4448)**

- Being developed by a pharmaceutical company as a reversal for Factor Xa inhibitors
- Phase 2 studies are now being tried in volunteers
- Until something is approved, use of PCCs, time, and dialysis are the only potentially effective methods to consider
- Acts as Factor Xa decoy and sequesters the anticoagulants permanently until eliminated

**When the bleeding stops...**

- Only 10-25% of elderly patients are anticoagulated or on antiplatelet medications
- Even those patients that are not anticoagulated have increased morbidity and mortality
- Understanding all the significant risks will help improve the care of this high risk population
- There is more to elderly trauma than anticoagulation!
Why is this a concern?

- A large proportion of elderly patients that are injured do not survive.
- Of those that do survive, a significant number do not have a good functional outcome.
- Caring for these patients with poor prognoses has considerable emotional and financial tolls on the families and institutions that care for them.
- Mechanistic criteria that apply to younger trauma victims may not translate into the same risk of injury in the elderly.

What is the evidence?

- A recent study on GLFs shows how this simple mechanism is life changing in the elderly.
- *Ayoung-Chee P et. al retrospectively reviewed the outcome of 1,352 consecutive patients > 65 admitted after GLFs.
  - 48% had an ISS > 15.
  - In hospital mortality was 12% and the one year mortality was 33%.
  - Of the survivors discharge, 51% were sent to SNFs, and only 33% were DCed to home or assisted-living facilities.
  - Of those discharged to SNF 48% died by 28 months of follow up.


An early lesson!

- 74 y.o, female brought in after being bumped at low speed by a car.
- The patient was talking on arrival.
- There was barely a scratch on her.
- She was perserverating, "Oh honey, I'm alright, Oh don't worry about me, I'm alright.
- This was back in 1989.
- CT scanners were not routinely available at that time.
- Trauma surgeons were non-existent.
- DPLs were still being routinely performed.

External appearances can be deceiving!

- As we evaluated this patient for possible injuries, she slowly (over 4 hours) deteriorated.
- Alert and talkative.
- Somnolent and unresponsive.
- Dead.

Perplexing and disappointing at that time.

Predictable and possibly preventable now.

Undertriaged and unprepared.

Our bodily parts are not meant to last forever!

Physiologic changes in elderly that affect response to injuries (cont'd)

- Cardiovascular:
  - Cardiac function declines 50% between 20 and 80 years.
  - Response to hypovolemia may not be as expected initially.
  - More prone to arrhythmias.
  - Normal BP may represent "shock" with increased lactic acid level and base deficit.

Physiologic changes in elderly that affect response to injuries (cont'd)

- Pulmonary:
  - Decrease in compliance of the chest wall from aging.
  - Increased risk of respiratory failure/ARDS and VAP.
  - Decrease cough reflex, decreased mucociliary function, increased oropharyngeal colonization, and decreased response to foreign antigen.
  - Elderly with thoracic trauma have twice the morbidity and mortality than younger patients.
  - For each rib fracture the risk of pneumonia increases by 27% and the risk of mortality by 19%.

Physiologic changes in elderly that affect response to injuries (cont'd)

- Renal system:
  - Decrease renal mass over the age of 50.
  - Poorer clearance of some drugs.
  - The endocrine response to ADH and aldosterone is abnormal.
  - Increased risk for volume and electrolyte changes.
  - At risk for hyperkalemic metabolic acidosis.
Physiologic changes in elderly that affect response to injuries (cont'd)

Central nervous system
- Increased risk of SDH from minor mechanism
- Determining normal mental status can be challenging because of pre-existing dementia or impaired hearing

Skin, soft tissue and musculoskeletal system
- Loss of lean body mass and bone
- Increased risk of fractures, particularly the hip, vertebrae, and distal forearm
- Higher risk of C-spine fractures
- Skin changes lead to problems with open fractures

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Preexisting conditions (PECs) that affect outcomes
- Cardiovascular disease
  - CAD, CHF, valvular disease
  - Arrhythmias
  - Hypertension
- Pulmonary disease
  - COPD/asthma
  - Significant ongoing smoking history
- Restrictive lung disease
- Diabetes
- Other PECs that can affect outcomes
  - Liver disease
    - Cirrhosis (i.e. alcoholism)
    - Acute and chronic hepatitis
  - Kidney disease
    - Dialysis-dependent chronic disease
    - Transplant recipients
  - Neurologic disease
    - Severe dementia
    - Significant cerebrovascular disease
  - Chronic pain and substance abuse

Preexisting conditions (PECs)
- PECs impact morbidity and mortality in trauma patients
- Morris et al. identified five PECs that negatively influence outcomes in trauma patients regardless of the age
  1. Cirrhosis;
  2. Congenital coagulopathy;
  3. COPD;
  4. Ischemic cardiac disease;
  5. Diabetes

Mechanisms of geriatric trauma

Common mechanism for geriatric trauma
1. Motor vehicle collision/accidents
2. Falls
3. Burns/Fires
4. PHIV (pedestrian hit by vehicle)
5. Assaults (abuse is common)
6. Suicides and self-inflicted injury

Prevention is the key
Falls

- Most are from the ground level
- Mortality increases as the height of the fall increases
- Most falls occur within or around the home or place of residence
- The frequency of falls increases with age
- Not being able to walk does not eliminate the possibility of falling

Most common injuries from falls

- Hip fractures
- Traumatic brain injury (TBI)
  - SAH
  - ICC
  - Extra-axial hemorrhages (i.e. SDH, EDH)
- Rib fractures
- Spine injuries
- Other orthopedic injuries

Why do they fall?

Extrinsic factors

- Throw rugs, stairs, types of flooring
- Pets
- Unknown environments
- No assistance devices

Intrinsic factors

- Sensory-neuromuscular changes with age
- Medications
  - BP meds
  - Sedatives
  - Delirium and dementia

Case # 3

- 84 year old female
- Getting dressed in bathroom with foot on the toilet
- Foot slipped and the patient fell hitting her chest on the side of the tub and her head on the floor

How common is this?

Initial CXR

Initial chest CT
**Case # 3 (cont’d)**
- Hemodynamically stable
- History of CVA 4 years
- PTA
- On Plavix
- Very hard of hearing
- Minimal other comorbidities

- Multiple displaced rib fractures with a right hemopneumothorax
- Right scapular fracture
- Right 28 Fr. Chest tube placed without event

**Management principles**
- Adequate pain control
- Incentive spirometry with pulmonary toilet
- Proper chest tube management
- Mobilization
- Antibiotics?
- Intubation?
- Oxygen

**What happened?**
- Chest tube removed on HD 3?
- Patient intubated HD 2?
- Pneumonia settled in on HD 3, patient intubated and made comfort care on HD 7?
- Develops a flail chest and requires intubation, trach, G-tube and prolonged care?
- CT on suction for 3 days, water seal, removal on HD 5?
- Develops delirium HD 2, pulls out CT, recurrent PTX, empyema, sick?

**Case # 4**
- 95 y.o. female passenger in moderate speed MVC
- Restrained, no LOC
- Previously very active and alert
- Lived alone
- Came into the hospital with inability to move any of her extremities
- Had never been hospitalized previously for any medical condition
- Previous hip fracture

**CXR**

**CT chest**
Case # 4

- Full code
- Medical POA was her niece
- Did well initially for first 48 hours
- Progressively developed more respiratory distress and delirium
- Poor prognosis explained to the family
- Eventually family excepted this and patient expired from respiratory complication
- Had developed UTI and decubiti over 5 day period

How old is "old"?

- ATLS defines geriatric as > 55
- Most trauma centers would agree that age > 65 is considered elderly
- Several papers refer to the elderly as > 60
- Chronological age and physiological age are not equivalent, and there are several physiological changes that occur after the age of 50 that alter the ability to respond to injury

How old is geriatric?

- Frailty index
  - A measure of frailty obtained by counting various clinical deficits
  - Developed in 1991 out of the Canadian Study of Health and Aging (CSHA), it was started in as a prospective cohort of 10,263 patients 65 and older
  - It was aimed at describing the epidemiology of important health issues in elderly Canadians
  - Was not focused on injury

- Several deficit based scales have been derived from the Frailty index but none have been validated for use in the trauma patient.
Fragility score and outcomes

*Joseph B et al. used a frailty index to help stratify geriatric trauma patients into favorable or unfavorable discharge dispositions

- Favorable dispositions were considered discharge to home or rehab
- Unfavorable dispositions were considered discharge to SNF or death
- Prospective study of 100 patients at a Level I trauma center
- High FI correlated with unfavorable disposition with an odds ratio of about 1.3

*Joseph B et al., J Trauma Acute Care Surg, Jan 2014;76(1):196-200

A young octogenarian

- 86 y.o. female, recently recovered from fall 9 months earlier resulting in T-spine and L-spine compression fractures
- Visiting Pilot mountain with family
- Hit a pebble on sidewalk with walker after tour
- GLF, pain in left shoulder and left hip
- Could not walk, taken to closest trauma center (Level I, Baptist)
- Family requested transfer to Cone

Injuries

- Pubic ramus and acetabular fracture
- Left humeral neck fracture
- Left femoral neck fracture

Additional medical problems

- History of normal pressure hydrocephalus with ventriculoperitoneal shunt in place
- History of mild dementia
- History of previous CVA
- Not on many medications
Acetabular and pubic ramus fx

Hospital course
- Patient transferred to Cone and evaluated by the trauma service
- Orthopedic surgery saw patient and planned on early hemiarthroplasty of hip, fixation of humerus day after admission
- Patient tolerated procedure well
- Transferred to SNF four days after surgery

Why did this patient do well?
- Although prior history of problems, she had few active physiologic concerns
- Aggressive evaluation and management
- Surgery was performed in a timely manner, allowing for early mobilization
- However, the story is not over...
  - Too early to know what is the long-term recovery
  - Quality of life
  - Not all injuries are the same

Not all injuries are the same
- Some injuries have a poor prognosis regardless of the age, but certainly the older, more frail patients have worse outcomes
- Early aggressive management of frail and elderly patients is preferred to "writing them off" with an idea of whom to back off
- Even though some outcomes are predictable, it is difficult to "sell" this in the face of a clean, healthy history

Triage criteria to favor the elderly
- It has been recommended by the AAST, and incorporated by some institutions, that triage criteria include some consideration of the elderly or co-morbidities that frequently affect the elderly
- Level I physiologic criteria are not always sensitive enough to capture older patients in shock
- Level II mechanism criteria do not usually include low energy, low impact mechanism that can lead to significant injuries in the elderly

Triage criteria in the elderly
- *Shifflette VK et al showed in a review of the NTDB over a ten year period of over 800K patients, patients > 60 had an increased risk of morbidity and mortality
  - Threefold increase in morbidity and fivefold increase in mortality with ISS < 16
  - Twofold increase in morbidity and fourfold increase in mortality with ISS > 15
- Recommended increasing the level of activation for patients > 60

Cone modified triage criteria
- As part of the Level II activation criteria, patients > 65 are included for lesser mechanisms
  - Any MVC, Amn, A v P
  - Many patients are also anti-coagulated which is also considered in activation criteria
  - Falls > 5 ft, MVC, Amn, A v P

Linking triage criteria to ISS
- Injury severity scores are calculated values based on the level of injury in different body systems
  - Trauma registries use abbreviated injury scores (AIS) that are then tabulated for each organ system
  - The greater the level of injury, the higher the AIS score and therefore the higher the ISS score
  - Higher ISS scores correlate with increased morbidity and mortality in trauma patients
  - ISS is not calculated until after the patient has been admitted
  - Triage criteria attempt to categorize mechanisms, and anatomic and physiologic changes to correlate with ISS
  - How well this correlates helps to determine our under and over-triage rates

?
Case 6

Initial presentation & mechanism
- 52 year old female driver of a car involved in single vehicular accident
- The patient fell asleep at the wheel and rolled down an embankment at about 45-50 MPH with deployment of the airbag, but no ejection
- LOC
- Brought in on a spine board with a rigid C-collar in place
- She had a small laceration on the top of her head, bruising of her chest wall, foot, left shoulder and right arm

Based on this information should this patient be a trauma activation?
- Probably not

Initial vitals and complaints
- Her initial vital signs were BP 118/81, P 72, Temp 97.2, O2sat 96% on RA, GCS 15, RTS 12
- She was complaining of 10/10 lower back pain
- She was awake, alert and oriented
- Now should this patient be a trauma activation? If so what level activation (I or II)?

Activation level and initial response
- Patient was a Level II activation
- Initially seen by the EDP along with the rest of the trauma team

Past medical history
- Status post mitral and aortic valve replacement in 1994 at Baptist hospital for rheumatic heart disease complicated by prosthetic valvular endocarditis in 2001 and 2002 requiring replacing the prosthetic valves at Moses Cone in 2002
- Multiple septic cerebrovascular emboli prior to replacement and subsequently

Additional past medical history
- Chronic pain from headaches and spinal disc disease with narcotic use and abuse
- Status post shotgun injury to abdomen as a child requiring small bowel and large bowel resection
- Atrial fibrillation
- Chronic hypertension
- Why is all this important?

Additional past medical history (cont’d)
- Diabetes mellitus
- Hypertriglyceridemia/hypercholesterolemia
- History of chest pain without known CAD
- Chronic anticoagulation
- Hemorrhoids
- Bipolar disorder

Medications
- Lovenox 60mg SQ bid; Toprol XL 50 mg qd; Lantus 0.125mg qd; Ativan 2.5mg qd; Amiodarone 200mg qd; Valtrex; Skelaxin; Percocet, Liptor 40mg qd; Boniva; Potassium chloride; Valium
- Allergies: penicillins and Darvocet — could not tolerate coumadin
Frailty index for this patient

- FI approximately 0.20 to 0.40
- Although correlation have been made with FI and patient disposition, no correlation has been made with in hospital mortality and morbidity
- This is an opportunity for improvement

Major complaints

- Severe back pain and headache
- Inability to move her legs, but could move her toes and feet normally
- She had minimal pelvic soft tissue bruising and a laceration on her scalp which was not bleeding
- Otherwise her physical examination was normal

Initial labs and x-rays

- Hgb 13.1, Hct 39.5%, PT/INR 14.8/1.1
- CXR: no rib fractures, no pneumothorax, no hemothorax
- No other plain radiologic studies were performed
- What other workup would you do?

Major complaints

- Additional studies
  - The patient also received a CT scan of the head, neck, abdomen and pelvic
  - Also had dedicated thoracic and lumbar CT scan because of back pain

CT scan results

- CT scan of the head demonstrated no acute findings but old right temporo-parietal infarct
- CT scan of the C-spine was negative
- CT scan of the chest, abdomen and pelvis demonstrated no acute soft tissue injuries or acute hemorrhage
- The patient had an acute T-11 anterior body compression fracture and a L-4 burst fracture

CT scan of the abdomen and pelvis read as having no acute abnormalities
Spine fractures

Disposition
- The patient was admitted to the SDU on the trauma service with consultations from neurosurgery and internal medicine.
- She was kept on all her home medications including her Lovenox.
- She was placed on strict bed rest x 14 days—the patient was a good operative candidate for stabilization.

Initial hospital course
- HD #1
  - Hgb dropped from 13.1 to 10.9
  - She was transferred to the floor
- HD #2
  - BP 91/61, P 70
  - The patient was lethargic and had slurred speech
  - Hgb dropped from 10.9 to 9.7
  - Repeat head CT done without contrast and abd/pelvic w/contrast

Continued hospital course
- Repeat CT of the head demonstrated a subcortical CVA with a large basal ganglial infarct.
- Abdominal and pelvic CT demonstrated a posterior inferior splenic laceration without intraperitoneal hemorrhage.
- Improving left retroperitoneal hemorrhage associated with L-4 burst fracture.
- Slow drop in hemoglobin attributed to retroperitoneal hemorrhage associated with L-4 burst fracture.
- She was transfused 2 units of PRBCs on HD #3.
- HD #4 Hgb improved to 11.4 with transfusions.
- HD #5 Hgb increased from 11.4 to 11.5.
- HD #6 no routine labs ordered, but patient found to be pancy, pale—CBC ordered.
- Hgb came back to 6.5.
- The patient received two more units of PRBCs and repeat CT of abdomen and chest performed.
Findings at operation

- The patient was taken to the O.R. in the early morning of HOD #7 where an uneventful splenectomy was performed.
- The patient received two units of blood bank and two units of Cell Saver blood.

Postoperative course

- Complicated by atrial fibrillation which was controlled.
- Eventually was able to ambulate with TLSO brace in place.
- Received post-splenectomy immunizations in the hospital.
- Anti-coagulation continued postoperatively.
- Transferred to rehab on HOD #17.

Key issues

- The patient was only in her fifties.
- Physiologically she seemed much older.
- Her mortality risk and morbidity should have been significantly affected by her fragility index.
- Her anticoagulation could not be stopped because of her significant risk of stroke.
- In spite of the many co-morbidities, the patient tolerated this trauma well.

“Medical” trauma service

- Over the years trauma has become more of a non-operative service.
- As diagnostic techniques have improved, the need for operative management for most trauma patients has diminished.
- Triage criteria have expanded to include special consideration for elderly patients that require less to induce injuries.
- Trauma centers are required to oversee and monitor all “trauma patients.”

“Medical” trauma service

- The older the patient the more likely the medical problems outweigh the traumatic injuries.
- What brings them to the hospital does not necessarily keep them there.
- There is some evidence that a “medical” trauma service would be appropriate.
- One study out of Swedish hospital in Colorado demonstrates comparable outcomes on a “medical” trauma service.

Advanced directives and quality of life

- Advanced directives are put together to avoid prolonged interventions near the end of life.
- We frequently focus on the preservation of life without understanding or appreciating the quality of life (or lack there of).
- Although we can often get patients to live and leave the hospital, we do not usually follow them long term.
Quality of life

- Trauma patients, regardless of age, have diminished lifestyles and functional status depending upon the severity of trauma
- The older the patient, the less trauma is needed to significantly affect subsequent quality of life
- Elderly patients have marked impaired quality of life after trauma, bringing into questions what efforts should be taken to preserve life

Conclusions

- Trauma in the elderly patient is more than a difference in chronological age
- Anatomical and physiological changes increase the likelihood of injury and alter their response
- Medications common in the elderly population significantly affect their ability to recover
- Quality of life and end of life issues must be considered in this patient population

Conclusion (cont’d)

- More elderly patients are requiring hospitalization because of frailty and because we have such sensitive devices (i.e. multi-panel CT scanners) that we are finding problems not seen before
- Specific treatment for many of these identified problems is not tested
- A medical "trauma" service can be useful in managing this select group of patients