

# GERIATRIC TRAUMA



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# INTRODUCTION

- Lower limit of geriatric age group , as young as 55 & as old as 80
- Malaysia
  - Life Expectancy – 73 years
  - Male – 70.3 years
  - Female – 75.9 years
  - 5% population > 65 years old
- US data: >65 will increase from 13% to 16% by 2020 & to 20% by 2040
- World population > 65 years
  - 4% of current population
  - More than 20% by 2050
- Elderly less likely to be involved in trauma, but more likely to have fatal outcomes, mortality 2x than younger patients

**PERSPECTIVE**

## 65 Years old is still young!

**H**ow old is old? World Health Organisation (WHO) had declared that 65 years old is still considered young. Before, based on the Friendly Societies Act (1875) in Britain, old was defined by age of 50. The UN has not adopted a standard criterion but lately 60 years old was referred as the border age to the word 'old'. However the health organisation had done a new research recently, according to average health quality and life expectancy and defined a new criterion that divides human age as follows:

- 0 to 17 years old: underage
- 18 to 65 years old: youth or young people
- 66 to 79 years old: middle-aged
- 80 to 99 years old: elderly or senior
- 100+ years old: long-lived elderly



- All elderly major trauma patients should receive the same standards of care as for any adult major trauma patient



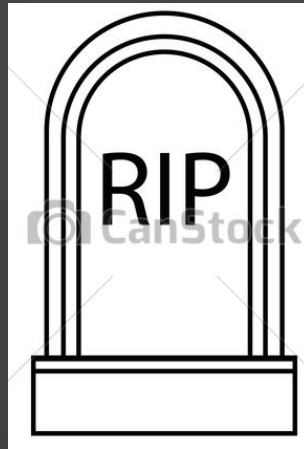
# AGE

- **Chronological age** : actual no of years the individual has lived
- **Physiological age** : functional capacity of the patient's organ system
- **Psychological age**: how old one feels, acts, and behaves



# MORTALITY

- Studies have shown :
  - ↑ age associated with ↑ mortality
  - Comorbid diseases associated with ↑ mortality



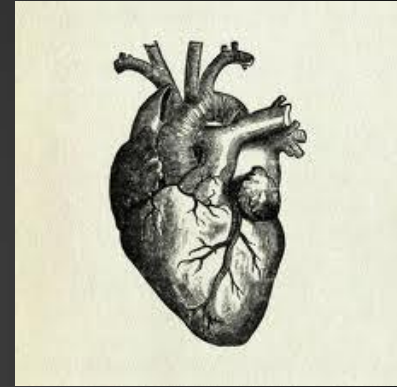
# PHYSIOLOGICAL CHANGES

- Physiological changes of aging **make assessment more difficult & complicate recovery** from injury
- Ageing, comorbid disease, medications and frailty may all affect the expected physiological presentation of major trauma in elderly people.



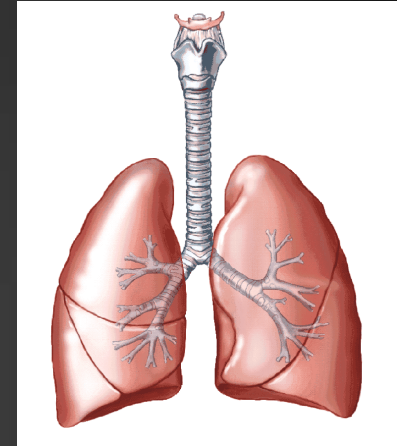
# PHYSIOLOGY OF AGING - CVS

- Myocytes replaced by collagen
- Decreased contractility & compliance for any given preload
- Lower cardiac output (only 50% compared to 20yrs old)
- Maximum tachycardic response decreases
- Decreased chronotropic response to catecholamines
- Aging of the electrical conducting system
- Pharmacologic activity of beta-blockers, calcium blockers or digoxin impairs tachycardic response
- Impaired body ability to compensate for haemorrhage & **making HR an unreliable predictor of hypovolemia**



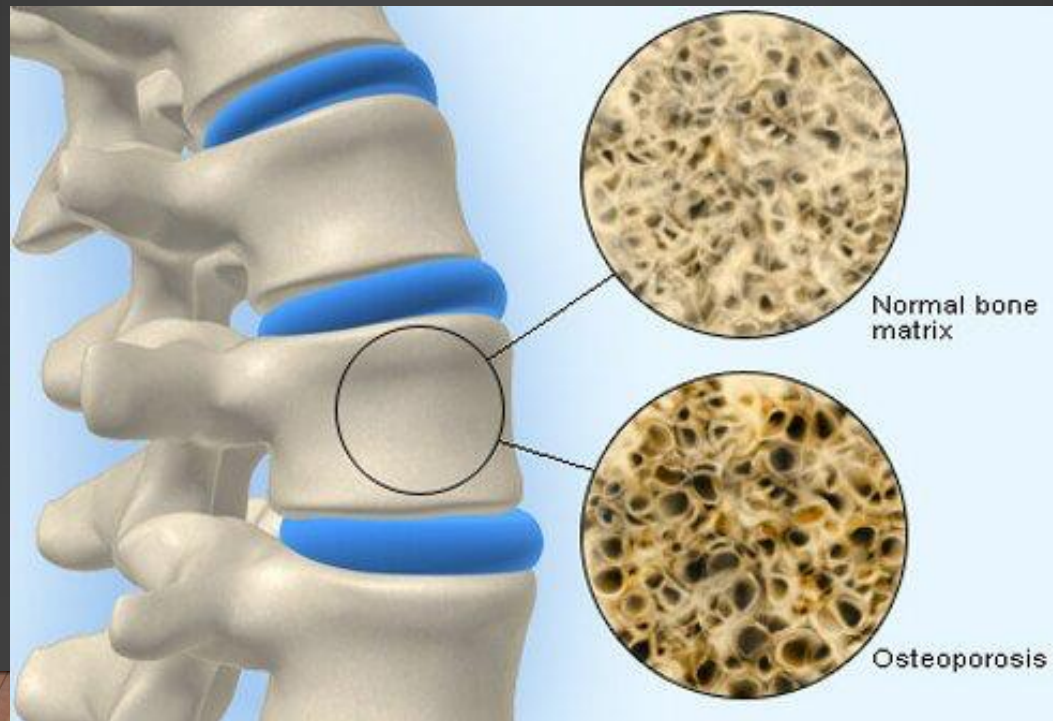
# PHYSIOLOGY OF AGING - *RESPIRATORY*

- Chest wall compliance ↓
- Respiratory muscle strength ↓
- Degenerative changes on chest wall
- Alveolar loss and decreased diffusion capacity
- Max inspiratory & expiratory force ↓ by up to 50%
- VC, FEV and FRC ↓
- ↓ Number of cilia, more mucus producing cells
  - Prone to get lungs infection
- Response to hypoxia & hypercarbia ↓



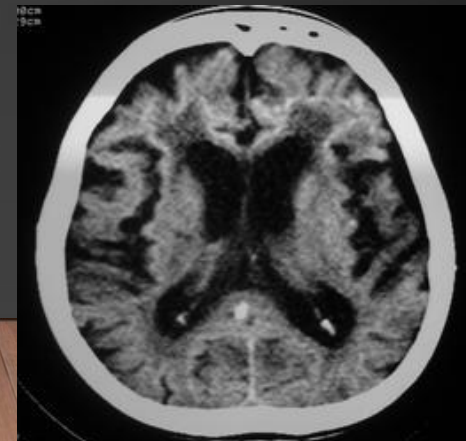
# PHYSIOLOGY OF AGING - *BONE*

- Osteoporosis
  - Less able to withstand the mechanical forces of trauma
  - Lesser kinetic energy can cause fractures



# PHYSIOLOGY OF AGING - *BRAIN & SPINAL CORD*

- Brain atrophy :
  - *Increases intracranial free spaces, allowing blood to accumulate without initial sx & sx*
  - *Greater stretching & tension of the bridging veins that pass from the brain to the dural sinuses : more susceptible to trauma tears*
- Denser fibrous bond between dura matter & inner table of skull, ↓ prone to develop EDH
- Decline in cerebrovascular autoregulation
- Loss of water & proteins affect shape of the IVD



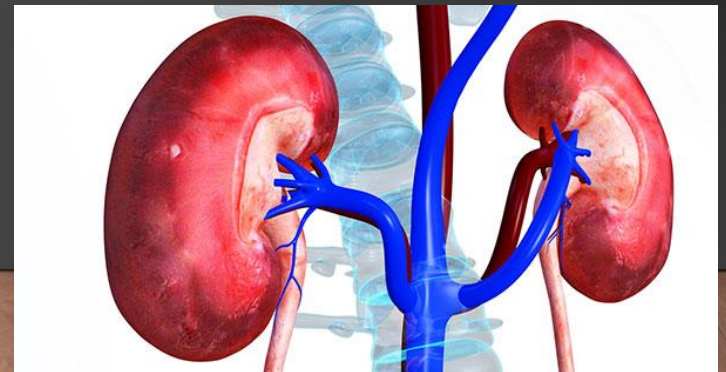
# PHYSIOLOGY OF AGING - *SKIN*

- Principal functions of the skin include protection, excretion, secretion, absorption, thermoregulation, pigmentogenesis, accumulation, sensory perception and regulation of immunological processes ; **most function reduced by 50-60%**
- Reduced defenses against microorganisms
- Delayed wound healing
- Loss of temperature autoregulation
  - Hypothermia



# PHYSIOLOGY OF AGING - *RENAL*

- Renal function declines with age
- Predispose patients to dehydration
- Requires medication dose adjustments based on calculated creatinine clearance
- Susceptible to contrast induced nephropathy



# MECHANISMS OF INJURY



# COMMON MECHANISMS OF INJURY

- 1) Falls (60.7%)
- 2) Motor vehicle crashes (21.5%)
- 3) Pedestrian-motor vehicle collisions
- 4) Burns



# FALLS



- Most common cause of fatal & non fatal injury in >65 yrs
- 1/3 of older adults fall annually, **rate increases with age**
- **Low level falls** may result in **significant injury**
- **Hip # : most common #** following fall
- Fall in Bathroom & on stairs are concerning
- Unable to get help for long period after a fall should prompt investigations for rhabdomyolysis & dehydration

## COMMON CAUSES OF FALLS IN ELDERLY

### Associated with syncope / loss of consciousness

Dysrhythmias  
Seizures  
ACS  
Hypoglycemia  
PE

### Associated with near syncope / positional change, vasodilation (eg. hot water)

Anti hpt meds (BB, CCB, Diuretics)  
Postural hypotension  
Fluid & electrolyte imbalance  
Haemorrhage (GI, AAA)  
Hot bath or shower  
Sepsis  
Anemia

### Nonsyncopal , “mechanical” causes

Impaired postural stability, balance, motor strength, coordination, reaction time, gait disorders  
Sensory impairment (eg. visual, vestibular)  
Unsafe home condition (eg. poor lighting, loose rugs)  
Sedating meds (BDZ, anti-histamines, sleep aids)  
Neurologic disease ( CVA, Parkinson's)  
Cognitive & Psychological conditions (eg. dementia, delirium)

# MVA

- 2<sup>nd</sup> most common cause of trauma in elderly & are the leading cause of death
- Fatality rate 2x than of those <65
- High risk elderly group :
  - *Presence of acute and chronic medical conditions that affect vision, hearing, reflexes, balance and cognition*



# PEDESTRIAN-MOTOR VEHICLE COLLISIONS

- Second only to children as victims
- 53% fatality rate
- High risk group:
  - *Slow ambulation*
  - *Impaired reflexes*
  - *Misjudgment*
  - *Visual, auditory and gait impairment*



# BURNS

- There is direct relationship between age & burn mortality, evidenced by traditionally taught **Baux score : sum of age & burnt BSA yield the percentage of likelihood of mortality**
- In patients >65, 50% mortality anticipated with 28% BSA burn
- Among the reasons why elderly are more prone to get burn injury:
  - *Smoking in bed*
  - *Memory impairment : forgets to off the cooking stove*
  - *Spill boiling water due to poor coordination & muscle strength*
  - *Difficulty to escape when caught in building/house fire*
- *Co morbid illness such as DM/IHD complicates treatment & outcome*





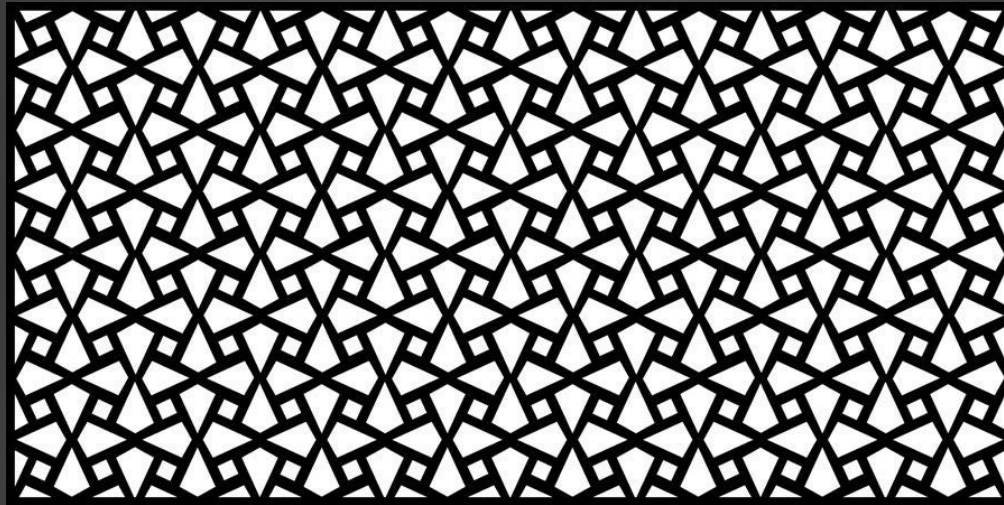
# ELDER ABUSE



- Maintain high suspicion for intentional injuries & injuries caused by neglect
- Warning signs include:
  - *Poor hygiene*
  - *Untreated decubitus ulcers*
  - *Injuries not explained by the reported mechanism*
  - *Subacute injuries in various stage of healing*

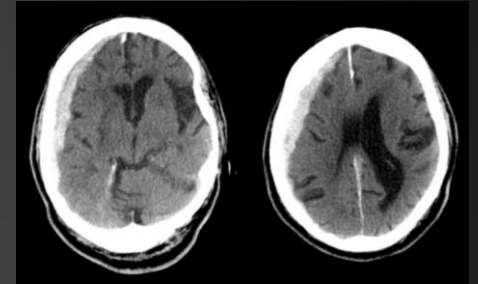


# PATTERNS OF INJURY



# HEAD INJURY

- GRAVE ERROR to assume alteration in mental status are due to dementia or senility
- There should be a low threshold for obtaining a head CT (+cervical) in the elderly especially in the following presentations:
  - *When known or suspected to have sustained head injury.*
  - *Following a low level fall (eg from standing or sitting).*
  - *When taking prescribed anticoagulant medication*
  - *When there is no clear medical cause of fall or unclear reason for ED attendance.*
- Elderly are ↓ prone to get EDH, ↑ incidence of SDH & intraparenchymal bleed
- **Diagnosis** maybe **delayed** due to late manifestation of signs & symptoms
- Risk ↑ if patient taking Warfarin & Clopidogrel: one study of blunt head trauma patients taking warfarin with minimal or no sx found a rate of injury on CT that changed disposition in 7%
- Risk conferred by other anticoagulant is less known



# CERVICAL SPINE INJURIES

- Elderly patient 2X likely to get cervical injury
- Commonest is odontoid # : 20%
- Low threshold for imaging
- **CT** is the preferred initial modality
- Identification of one # should prompt **imaging** of the entire spinal column
- **Assessment, imaging and reporting should be completed fast** so that patients are not held in a rigid cervical collar for long duration
- Elderly are at **↑ risk of pressure ulcers** as a result of immobilisation in **hard collars** and poorly tolerate being laid flat
- Patients kyphosis/lordosis may not be able to tolerate standard rigid cervical collars due to their postural alignment and should be held with **soft padding and tape**



**Figure 3-17 (continued)** (a) In an elderly patient with curvature of the spine, place padding behind the neck when immobilizing a patient to a long spine board. (b) Additional padding, such as rolled blankets or towels behind the head, may be needed to keep the head in a neutral, in-line position. (c) Secure the patient's head with a head immobilizer device. To prevent spinal damage, maintain manual stabilization until the head is secured.



# THORACOLUMBAR SPINAL INJURIES

- Accounts for almost  $\frac{1}{2}$  of all osteoporotic #
- Most common at T12-L1 (thoracolumbar junct) & T7-T8
- Anterior wedge compression # are most common
- CT scan is 1<sup>st</sup> line imaging

# SPINAL CORD INJURY

- Although uncommon, there is increased risk of spinal cord injury (SCI) in the elderly due to degenerative disease and canal stenosis, with incomplete cord syndromes possible from relative low energy mechanisms

# CHEST TRAUMA

- More susceptible to chest injuries from blunt trauma
- Decreased ability to compensate
- **Most common is rib #**, often lead to morbidity, pneumonia & death
- Rate of pneumonia & mortality 2X than younger patients
- **Mortality rises** significantly with each **additional fractured rib**
- More likely to develop pulmonary **complications**
- Because of significant mortality associated with rib # in elders, CT maybe necessary to assess the extent of the injuries

# ABDOMINAL TRAUMA

- Abdominal examination unreliable
- **FAST is an ideal imaging** study to detect free fluid
- Maintain high suspicion of intra-abdominal injuries in those with associated pelvic & lower ribs #
- Many solid organ injuries can be managed conservatively
- Rates of successful non-operative management of splenic injuries in elderly range from 62-85%
- **Contrasted CT** is valuable diagnostic test to evaluate extent of injury & ongoing bleed in **stable patients**
- Risk of contrast induced nephropathy increases with age, hypovolemia, diuretic, nephrotoxic meds, dm & renal disease

# ORTHOPEDIC INJURIES



# PELVIC FRACTURES

- Elderly esp **women suffer pelvic # from low-energy falls** to the ground from standing or seated position
- **Most common** injury & mechanism: **Pubic Rami # & Lateral compression**
- **If X ray negative** in stable patients with pelvic tenderness, **CT** should be ordered
- Xray insensitive for posterior # involving sacrum & iliac wings
- Even CT maybe only 77% sensitive to detect pelvic # in elderly, particularly undisplaced posterior # in osteoporotic bone
- MRI should be considered for patients with persistent pelvic pain or pain on weight bearing with negative CT imaging
- One study found that 94% of patients >60 taken to angiography required embolization, 52% in younger patient, author suggested liberal use of angiography in elderly patients with significant pelvic injury
- **Mortality is very high in elderly with major pelvic injury**

# HIP FRACTURES

- Single most common injury diagnosis that leads to hospitalization in elderly
- 25% dies within a year of injury
- Majority caused by falls
- Incidence is 2x more in women
- NOF # & IT # are equally common
- Plain radiographs, AP & Lat are 90% sensitive
- Normal plain radiograph should be followed by more definitive imaging (CT/MRI) in patients with high suspicion of hip #



# UPPER EXTREMITY INJURIES

- Colle's # are most common
- Caused by fall on outstretched hand, a/w osteoporosis
- Displaced # requires CMR
- A systematic review of unstable distal radius # showed that functional outcome were similar for operative & non operative management
- Proximal humerus # & humeral shaft # are also common after falls from standing, must assess for axillary nerve injury



# ASSESSMENT

# PRE HOSPITAL

- EMS provider **must be able to recognize that minor trauma mechanisms in elderly may result in significant injury**
- The threshold for scene triage to a tertiary centre should be lower
- **Traditional triage criteria of physiology (HR,BP), anatomical injury & mechanism are unreliable in elderly**
- Lower threshold for triage is recommended, **3 important points to remember :**
  - 1.Risk of injury/death increases after age 55 years
  - 2.SBP <110mmhg might represent shock after >65 yrs
  - 3.Low impact mechanisms might result in severe injury
- Elderly can rapidly develop tissue damage leading to decubitus ulcer, consider padded cervical collar, backboards or vacuum splints for prolonged transport

# PRIMARY SURVEY

# AIRWAY

➤ **Anatomic variations** may complicate airway management

➤ **Issues**

- Dentures
- Nasopharyngeal fragility
- Macroglossia
- Microstomia
- Arthritis – TMJ / cervical
- Degenerative changes



# AIRWAY

- Principles – SAME !
- Consider early intubations
- Proper pre oxygenation is crucial

# BREATHING & VENTILATION

- Elderly have **blunted response to hypoxia, hypercarbia & acidosis** which can mask signs of respiratory failure
- Other Issues
  - u/l Lung pathology eg. COAD
  - Chest Wall injuries
    - Rib fractures / Pulmonary contusion
  - Pain control & chest physiotherapy
  - Judicious Fluid therapy
    - Pulmonary oedema / worsen contusion
  - Pulmonary complications
    - Atelectasis, pneumonia, pulmonary oedema

# CIRCULATION



- Avoid feeling reassured by "NORMAL" vital signs
- Tachycardic response to hypovolemia or pain may be absent or blunted
- Medications such as B-blocker may mask tachycardia
- BP is also misleading in elderly, most have preexisting hypertension thus clinician must use higher cut off for hypotension
- Use BP <110mmhg or decrease in BP by >30mmhg from known baseline & HR >90 as cut off for hypertension & tachycardia
- Cautious with fluid administration esp those with comorbid eg. CCF, ESRF
- Early & aggressive monitoring of CVS

# DISABILITY

- Do not assume that alterations in mental status is due to dementia or senility
- Difficulty to assess pupils due to cataract
- In elderly trauma patients with cognitive impairment, look for the non-verbal manifestations of pain.

# EXPOSURE & ENVIRONMENT

- Prevent hypothermia
  - Warm fluids
  - Warm blanket
  - Monitor temperatures regularly
- Early irrigation & wound cover: very prone to get infection thru injured skin

# SECONDARY SURVEY

# HISTORY

- Detailed history is important
- Ask patient, relatives & pre hospital care providers about the exact events leading up to the injury
- The systemic review, past medical & medications list are important
- Identifying the cause of fall may uncover serious underlying medical causes
- **Always treat injured elders as both trauma & medical patients**
- Check for any advanced directive/DNACPR (if not already ascertained).

# CO-MORBID ILLNESSES

- Cardiovascular diseases
  - Ischaemic heart disease, hypertension
- Respiratory
  - Chronic obstructive pulmonary disease
- Neurology
  - CVA
  - Alzheimer/Dementia
- Liver disease
- End stage renal failure
- Metabolic disease
  - Diabetes mellitus, hypothyroidism

# PRE-EXISTING MEDICATION

- Antihypertensive: beta-blockers, CCB
- Anticoagulant: Warfarin, aspirin, clopidogrel
- Psychotropic medications



“Hypotension should never be attributed to antihypertensive until **hemorrhage** has been ruled out”

# SECONDARY SURVEY

- Thorough secondary survey is essential to uncover less serious injuries
- May not complain of pain at injured site because of high pain threshold
- Patients with no apparent life threatening injuries can have potentially fatal injuries if there is some degree of limited physiological reserve
- Can deteriorate rapidly without any warning

# LAB & BEDSIDE TESTING



- Requires **more intensive** lab evaluation
- **Helpful to identify co morbid diseases (eg. RP,) or acute causes of syncope (eg. Hb, Troponin, ECG, Dxt) or to uncover physiologic insults (eg.Lactate, INR, BE)**
- Base excess & Lactate levels are useful initial indicators of shock, serial measurements can guide resuscitation progress
- ↑ Lactate correlate with systemic hypoperfusion, ICU & hospital length of stay & mortality
- Check **CK to assess for rhabdomyolysis** in patient who fell & been unable to receive assistance for a prolonged period

# TREATMENT

# BLEEDING & HEAD INJURY

- Volume of intracranial blood & haematoma expansion are the most important determinants of morbidity & mortality in head injury
- Rapid reversal of anticoagulation is required in those taking warfarin with ICB on CT scan
- It is also reasonable to reverse other forms of anticoagulation (aspirin, clopidogrel, heparin, LMWH, NOAC)
- Management of patient on warfarin but with normal initial CT is challenging: reported rate of delayed ICB is between 1%-8%. Admission for repeat CT at 24H will catch most
- Also reasonable to discharge those with negative initial CT + low INR, but caregivers must watch them closely at home
- Consult Neurosurgical team early

# RIB FRACTURES & RESPIRATORY FAILURE

- **Low threshold for admitting patients with rib # for observation** until good pain control & chest physiotherapy are assured
- Severe thoracic injuries such as haemopneumothorax, flail chest & contusion can lead to rapid decompensation in those with baseline respiratory insufficiency
- **Pain control is vital:** encourage ventilation, prevent atelectasis & infection
- Pain control is challenging: may have ↓ tolerance for opioids
- Consider early intubation & mechanical ventilation in patients with severe injuries

# SHOCK

- **Hypovolaemic shock** may be **difficult to detect** due to pre existing hypertension, altered CVS reserve or B-Blocker therapy
- Resuscitate with **small volumes of warm isotonic crystalloids with frequent assessment** to avoid under or over resuscitation
- Consider **early & liberal use of blood products** which will enhance oxygen delivery, minimize tissue ischemia & prevent volume overload
- One study, showed marked increase of survival from 7% to 53% with early placement of pulmonary artery catheter (invasive) followed by goal directed volume resuscitation & inotropic support
- Less invasive assessment: USG, Se Lactate & BE

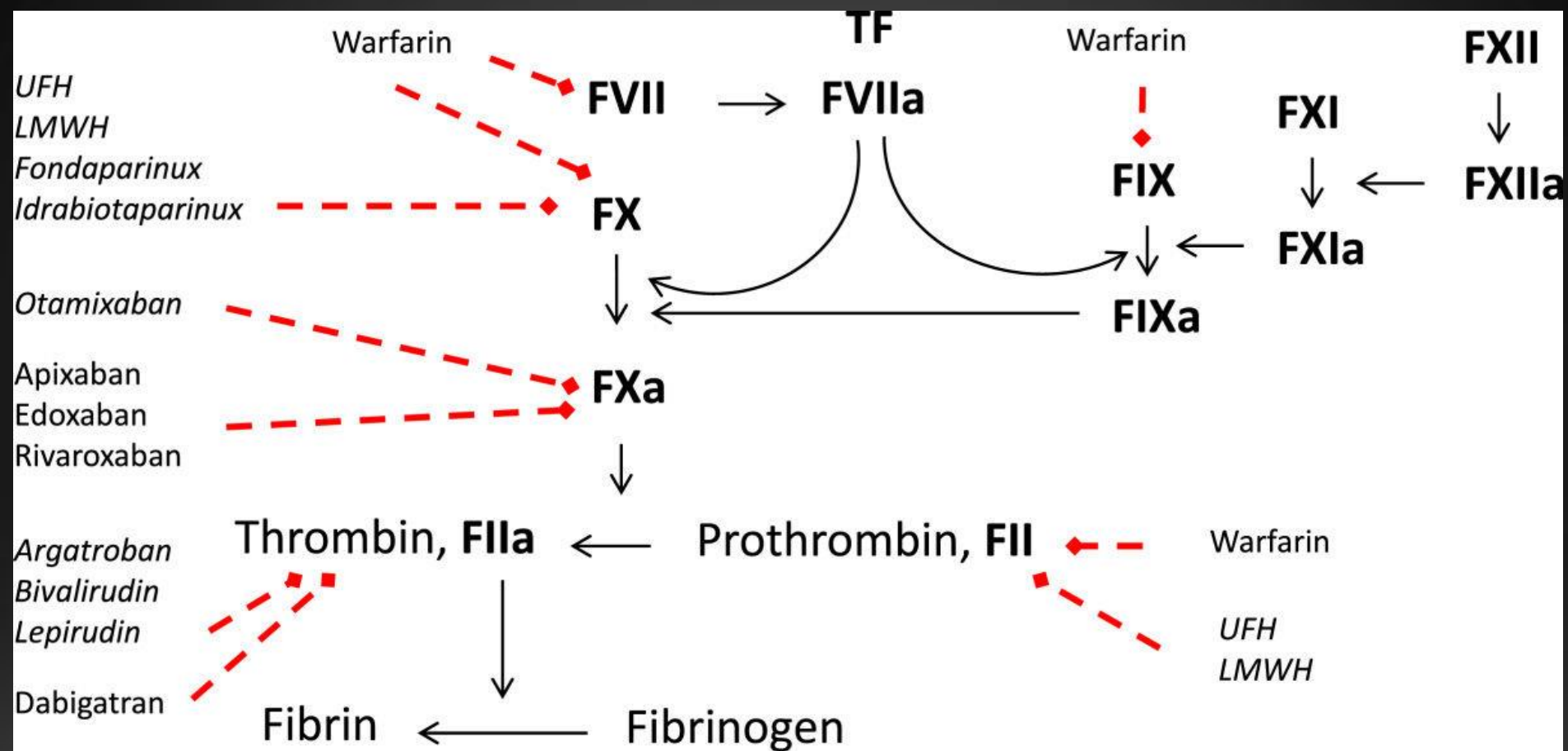
# ENVIRONMENTAL & IATROGENIC INJURY

- ↓ lean muscle mass & ↓ peripheral circulation makes elderly more susceptible to pressure sores & hypothermia
- Patient with prolonged extrication are at risk of hypothermia
- Keep patient covered as much as possible to maintain body heat
- Hypothermia not explained by environmental factors maybe sign of sepsis or endocrine abnormalities

# SPECIAL CIRCUMSTANCES

# REVERSAL OF ANTICOAGULATION

- Large no of geriatric patients are on anticoagulants for various reason, they might present to ED as trauma patients
- When they sustain a significant traumatic injury, timely reversal of these anticoagulants may become necessary
- Antiplatelets, Warfarin, Heparin, LMWH, NOACs
- One study estimated that about 3% of patients presenting to a level 1 trauma center were using warfarin, with a three-fold increase in mortality
- A working knowledge of reversal of anticoagulation induced by older and newer agents is essential for the treating clinician.



# WARFARIN REVERSAL

- For immediate reversal, **Prothrombin Complex Concentrates (PCC)** are preferred over Fresh Frozen Plasma (FFP)
  - **Prothrombinex-VF** is now available in Malaysia
  - It contains factors **II, IX, X** and low levels of factor **VII**
  - Prothrombinex-VF completely reverse an excessive INR within 15 minutes
  - The rate of achieving an INR  $<1.3$  within 30 min of completing therapy was 62.2% for PCC and 9.6% for FFP with similar thromboembolic events
  - FFP is not routinely needed in combination with Prothrombinex-VF (but consider adding it if INR  $>10$ ; add if life-threatening haemorrhage)
  - FFP can be used when Prothrombinex-VF is unavailable
  - Vitamin K is essential for sustaining the reversal achieved by PCC or FFP



# WARFARIN REVERSAL



- Management of patient on Warfarin with active bleeding

<b>Life threatening bleeding with INR&gt;1.5 or unknown INR</b>	<b>Hold warfarin therapy Give vitamin K (5-10 mg by slow IV), IV Prothrombinex VF 50IU/kg AND FFP 150-300mls</b>
<b>Significant bleeding ( not life threatening with INR &gt;2.0 )</b>	<b>Hold warfarin therapy Give vitamin K (5-10 mg by slow IV) IV Prothrombinex VF 35IU/kg OR FFP</b>
<b>Any INR with minor bleeding</b>	<b>Hold Warfarin,repeat INR following day &amp; adjust dose If bleeding risk is high or INR&gt;4.5, consider Vit K oral 1-2mg or IV 0.5-1mg</b>

# PLATELET INHIBITOR REVERSAL

- Many are on Aspirin or Clopidogrel (Plavix®)
- Controversy regarding management of these patients when they incur trauma
- No established guidelines for reversal of antiplatelet agents, one study in healthy volunteers found that 2-3 pools of platelets (either random donor 4-6 packs or apheresis units) induced a normalization of platelet function
- **Not enough evidence at this time to make routine platelet transfusion a “standard of care.”**

# OTHER ANTICOAGULANT REVERSAL

- Heparin & LMWH: Protamine Sulphate
- Direct Factor II Inhibitor (Darbigatran) : Idarucizumab (available in EDHKL), reverse within minutes
- Direct Factor Xa Inhibitors (Rivaroxaban, Apixaban, Edoxaban) : 4 Factor PCC



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# MASSIVE TRANSFUSION PROTOCOL IN ELDERLY

- Few studies have shown that when **MTP is activated, survival to discharge in elderly trauma patients is comparable to younger patients**
- Restrictive resuscitation or transfusion on the basis of age alone cannot be supported.
- **Beware of volume overload & underlying CCF/CKD**
- Early aggressive resuscitation of elderly trauma patients along specific guidelines directed at the geriatric population is required to improve outcome



# PERMISSIVE HYPOTENSION IN ELDERLY

- Permissive hypotension appears to be a **possible management strategy in elderly trauma patients**
- Study has shown that restrictive volume administration has a **positive effect on the initial coagulation status** in elderly patients.
- **Right shift of targeted SBP/MAP compared to the young might be a good strategy** esp in those with underlying hypertension



# DISPOSITION

- Low threshold for admitting geriatric trauma patient
- Admit patients with significant injury to ICU
- In patients whose pre injury mobility was already impaired, returning home early may be dangerous
- Observation for establishment of a safe & effective pain regimen, consultation with physiotherapist, & assurance of safe home environment may be advisable to prevent secondary injury

# OUTCOME

- Ultimate goal is to return the elderly trauma patient to the **pre injury state**
- **Advanced age is NOT a contraindication for active all out trauma resuscitation**
- Thus, **aggressive & thoughtful** resuscitation efforts for geriatric trauma patients are warranted
- Elderly trauma patients with multiple injuries are often only identified retrospectively and that prospective recognition of multiple injuries is key to improving overall care and outcomes

**A GOAL**  
without



is just  
**A WISH**

# REFERENCES

- Practice Management Guidelines for Geriatric Trauma: The EAST Practice Management Guidelines Work Group. *J Trauma* 2012;54:391-416.
- London Major Trauma System: Management of elderly major trauma patients, Feb 2017
- Deepak G. Darti D..Haemostasis in ICH. *Frontiers in Neurology*. March 2017
- Laura R.Thompson.Anticoagulation in Trauma Patients.Trauma Reports.Jan 2017
- Murry, Jason S. Activation of Massive Transfusion for Elderly Trauma Patients.The American Surgeon.81:10.
- Mitra B, Olaussen A.Massive blood transfusions post trauma in the elderly compared to younger patients. *Injury* 2014 Sep;45(9):1296-300
- Bridges LC. Waibel BH. Permissive Hypotension: Potentially Harmful in the Elderly? A National Trauma Data Bank Analysis. [\*Am Surg\*](#). 2015 Aug;81(8):770-7
- Linen M, Scholz A. Limited volume resuscitation in hypotensive elderly multiple trauma is safe and prevents early clinical dilutive coagulopathy -- a matched-pair analysis from TraumaRegister DGU(®). [\*Injury\*](#). 2014 Oct;45 Suppl 3:S59-63
- Tintinalli 8 th edition

# THANK YOU

