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Pregnancy in Trauma

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Objectives

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

- Discuss the epidemiology, incidence and prevention of trauma in pregnancy
- Identify physiologic & anatomic changes in pregnancy pertinent to trauma care
- Discuss resuscitative management unique to the pregnant trauma patient

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Epidemiology

- Leading cause non-obstetric maternal death
  - Around 50% of maternal deaths are caused by trauma
- 6-7% of pregnancies experience trauma
- Most common:
  - Motor vehicle crashes (MVC)
  - Falls
  - Battering or physical abuse

(Petrone & Marini, 2015)

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Who is at Increased Risk for Injury During Pregnancy?

- Young
- Non-Caucasian
- Driving unrestrained
- Intimate partner abuse
- Drug and/or alcohol abuse
- Low socio-economic status
- Pregnancy alone - independent risk factor!

(Petrone & Marini, 2015)

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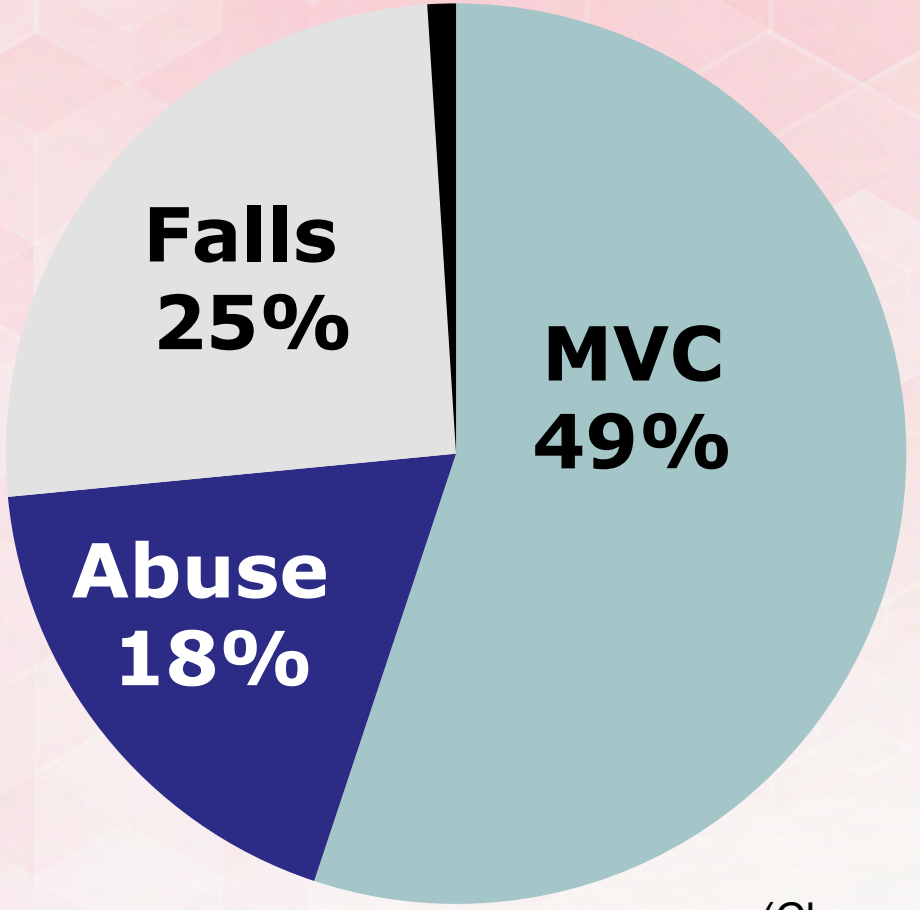
Mechanism of Injury

Most Common Mechanisms In Maternal Trauma



(Chames & Pearlman, 2008)

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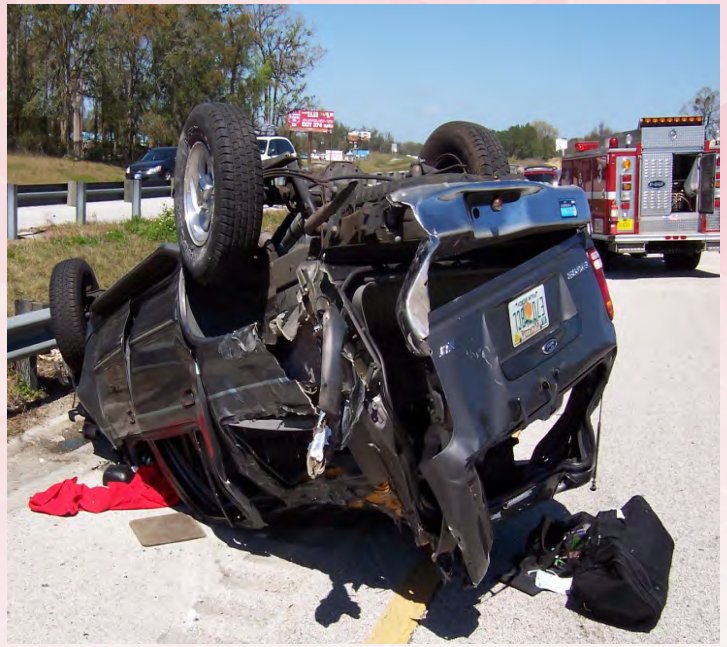
Mechanism of Injury: Motor Vehicle Crash

- MVC is a leading cause of maternal death
- In unrestrained patients fetal death 3 times more likely
  - Seatbelt Safety in Pregnancy
    - Misinformation Common
  - Only 46% of pregnant trauma patients use restraints
  - Only 50% of patients report receiving education seatbelt education from prenatal care provider



(Dobiesz & Robinson, 2017; Mendez-Figueroa, Mendez-Figueroa, Dahlke, Vress, & Rouse, 2013)

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Proper Seat Belt Positioning

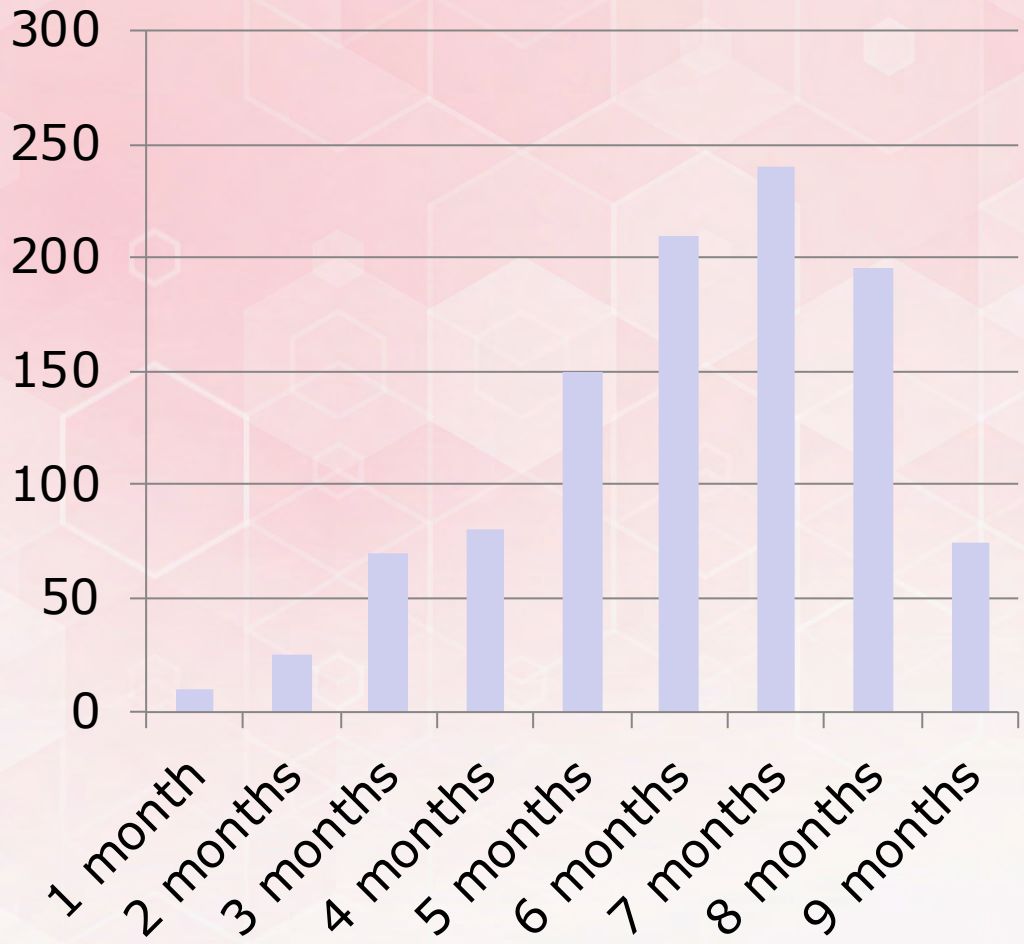
- **Shoulder belt**- mid-clavicular between breasts
- **Lap belt-** under abdomen

Mechanism of Injury: Motor Vehicle Crash

- Airbags are supplemental
  - Protective if patient restrained using three point harness
  - Positioning:
    - Sternum should be at least 10 inches from steering wheel
    - Tilt steering wheel towards sternum, not abdomen
  - More research is needed
- Distracted driving
- Use of alcohol or other intoxicant

Mechanism of Injury: Falls

- Related to anatomic and physiologic changes
- Fall details give clues to possible injuries
- High suspicion for abuse



(Dunning, Lemaster, & Bhattacharya, 2010)

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Mechanism of Injury: Intimate Partner Violence (IPV)

(Domestic Violence)

- Physical Abuse
  - Pushing, kicking, use of weapon
- Psychologic Abuse
  - Verbal abuse, isolation, degradation
- Sexual Violence
  - Sexual coercion, rape
- Reproductive Coercion
  - Refuse to practice safe sex, exposure to sexually transmitted infections, control of outcome of pregnancy

(American College of Obstetricians and Gynecologists Committee on Healthcare for Underserved Women, 2012)

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Mechanism of Injury: Intimate Partner Violence (IPV)

(Domestic Violence)

- Risk Factors:
  - Young
  - Single
  - Non-Caucasian
  - ↓ Socioeconomic Status
- Injuries to neck, breast, face, upper arms and legs
  - Compared to non IPV injuries which are usually more distal
- National Domestic Violence Hot Line

  1-800-799-SAFE (7233)

  1-800-787-3224 (TDD)

(Petrone & Marini, 2015)

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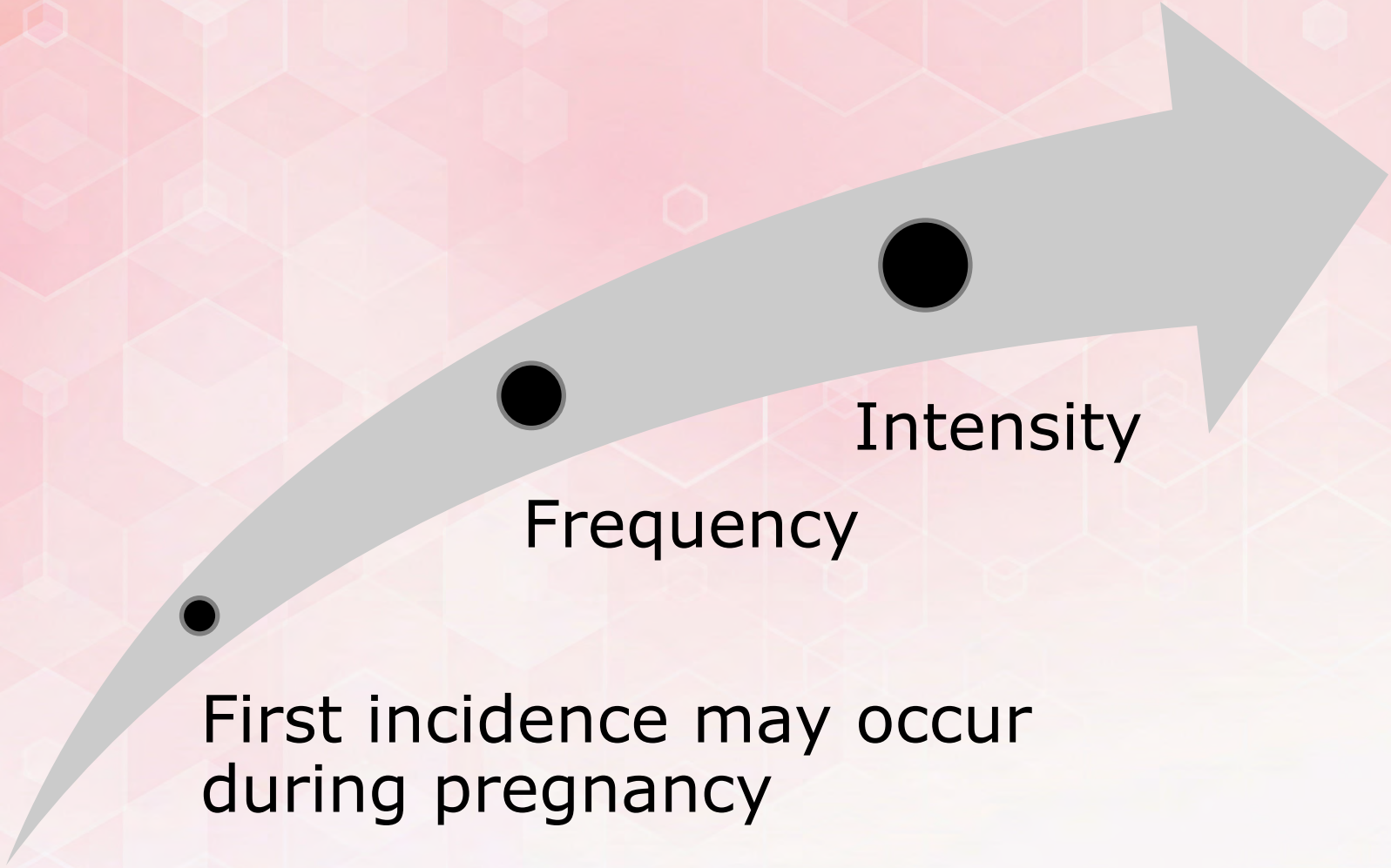
Intimate Partner Violence Progression During Pregnancy



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Intimate Partner Violence
Sample Screening Tool

(performed in absence of patient partner)

1. Have you ever been emotionally or physically abused by your partner or someone important to you?
2. Have you been hit, slapped, kicked, or otherwise physically hurt by someone during this pregnancy?
3. Within the past year has anyone made you do something sexual that you did not want to do?
4. Are you afraid of your partner or anyone else?

(Deshpande & Lewis-O'Connor, 2013)

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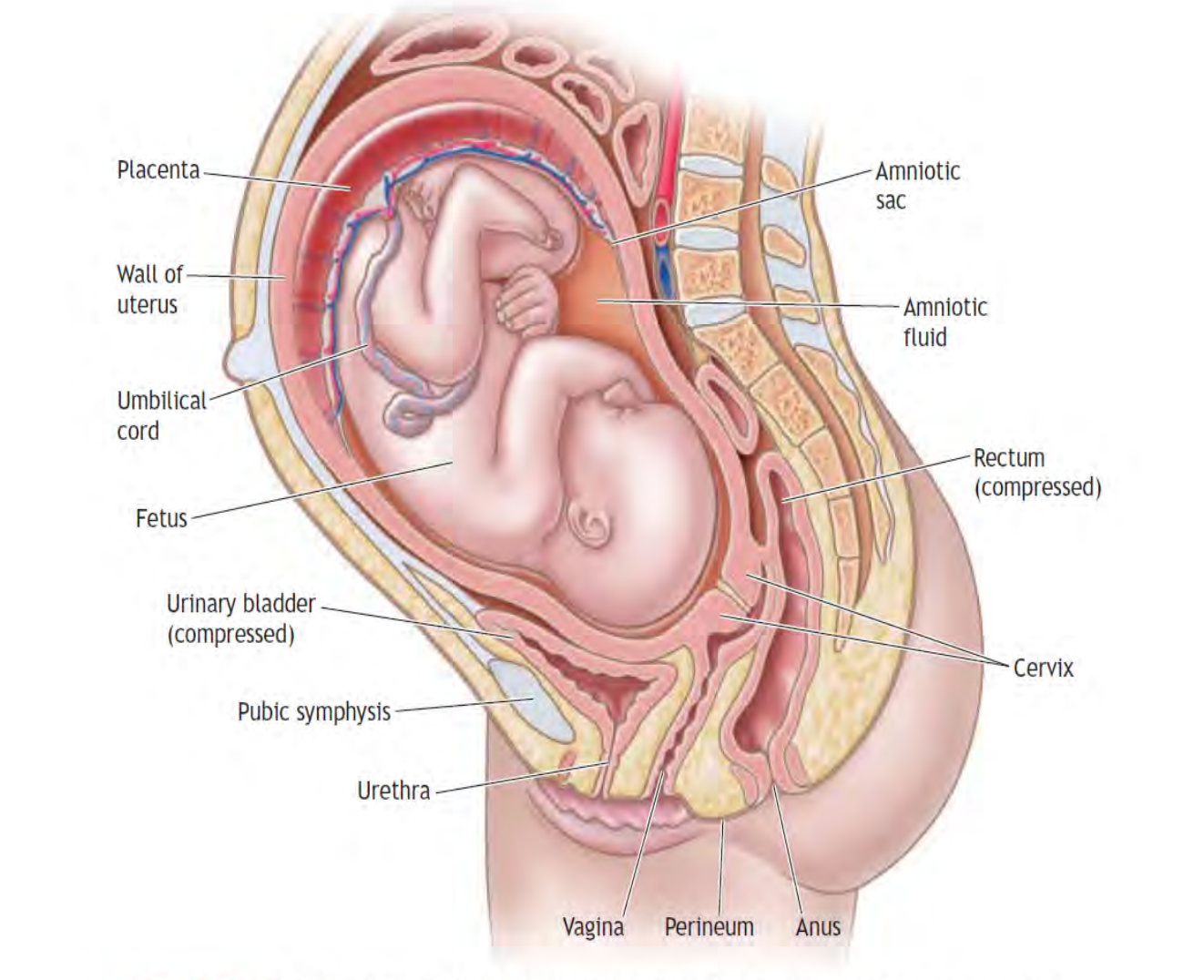
Physiologic Changes in Pregnancy



(American College of Surgeons, 2012) Used with permission

Hemodynamic Changes in Pregnancy

Heart rate 15-20 bpm

Blood volume by 50%

Cardiac output by 30-50%

BP by 15-20 mmHg

Systemic Vascular Resistance

HCT (dilutional anemia)

Net Effect May Mask Shock

(Krywko & Bhimji, 2017)

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Pulmonary Changes in Pregnancy

Engorged mucosa

Oxygen consumption 15-20%

Minute ventilation

Tidal volume

Resp Alkalosis

O2 reserve

Buffering capacity

Total lung capacity

Functional residual capacity

Intubate Early

Provide O2

High risk:
-Hypoxia

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Pulmonary Changes in Pregnancy

Arterial Blood Gas Values		
	Pregnant	Non Pregnant
pH	7.40 to 7.45	7.40
pCO2	27 to 32	39 to 40
pO2	100 to 108	95 to 100
Bicarbonate	18 to 21	24 to 29

(Kilpatrick, 2017)

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Neurological Changes in Pregnancy

Normal Changes

- Dizziness
- Syncope
- Balance changes
- Gait changes

Neurologic Complications

- Pre-eclampsia / Eclampsia
  - Hypertension
  - Headaches
  - Vision changes
  - Hyperreflexia
  - Seizures

Can mimic head injury!

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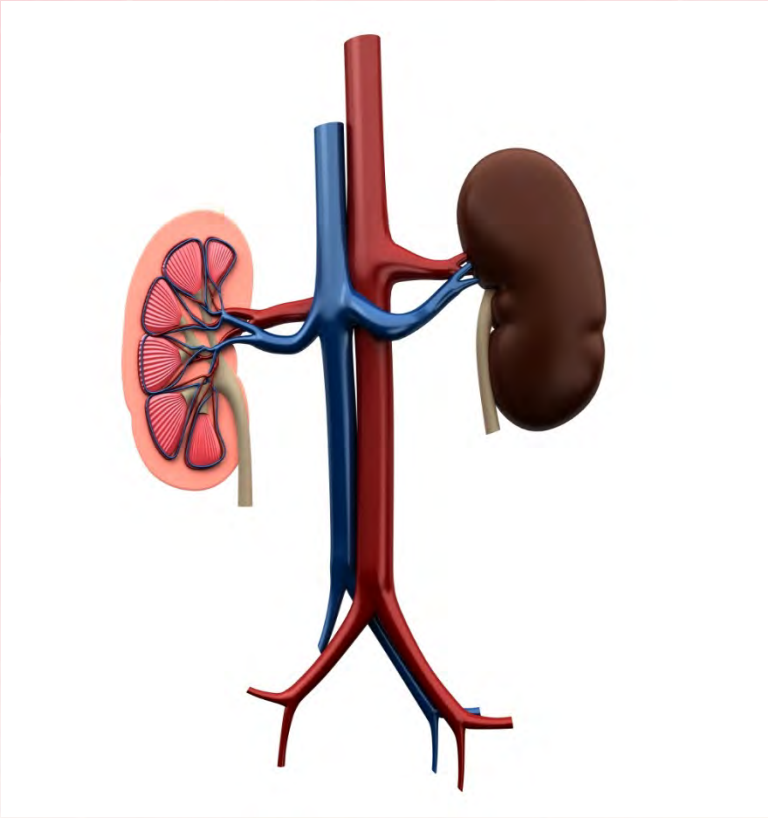
Gastrointestinal Changes in Pregnancy

- Decreased gastric motility
- Relaxed gastric and esophageal sphincters
- Bowel displaced, cephalad and anterior

(Krywko & Bhimji, 2017)

Urologic Changes in Pregnancy

- Increased pelvic blood flow
- Bladder
  - Displaced anterior and superior (> 12 wks)
  - ↑ risk for injury
- Increased glomerular filtration rate
- Low: BUN and creatinine



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Virchow's Triad in Pregnancy

(Simcox, Ormesher, Tower, & Greer, 2015)

Thrombotic Disease in Pregnancy

- Careful nursing assessment or signs and symptoms of VTE
- Recommended treatment:
  - Sequential compression devices
  - Low molecular weight heparin (instead of unfractionated heparin)
- CONTRAINDICATED:
  - Coumadin (adverse CNS effects, spontaneous abortion, fetal hemorrhage, and fetal death)

(Lexicomp, 2018)

Assessment and Management of The Pregnant Patient with Trauma

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Preparation and Team Work

- Trauma Team
- Obstetrician
- L&D Nurse
- Consult radiologist for radiation exposure
- Neonatologist
  - imminent delivery

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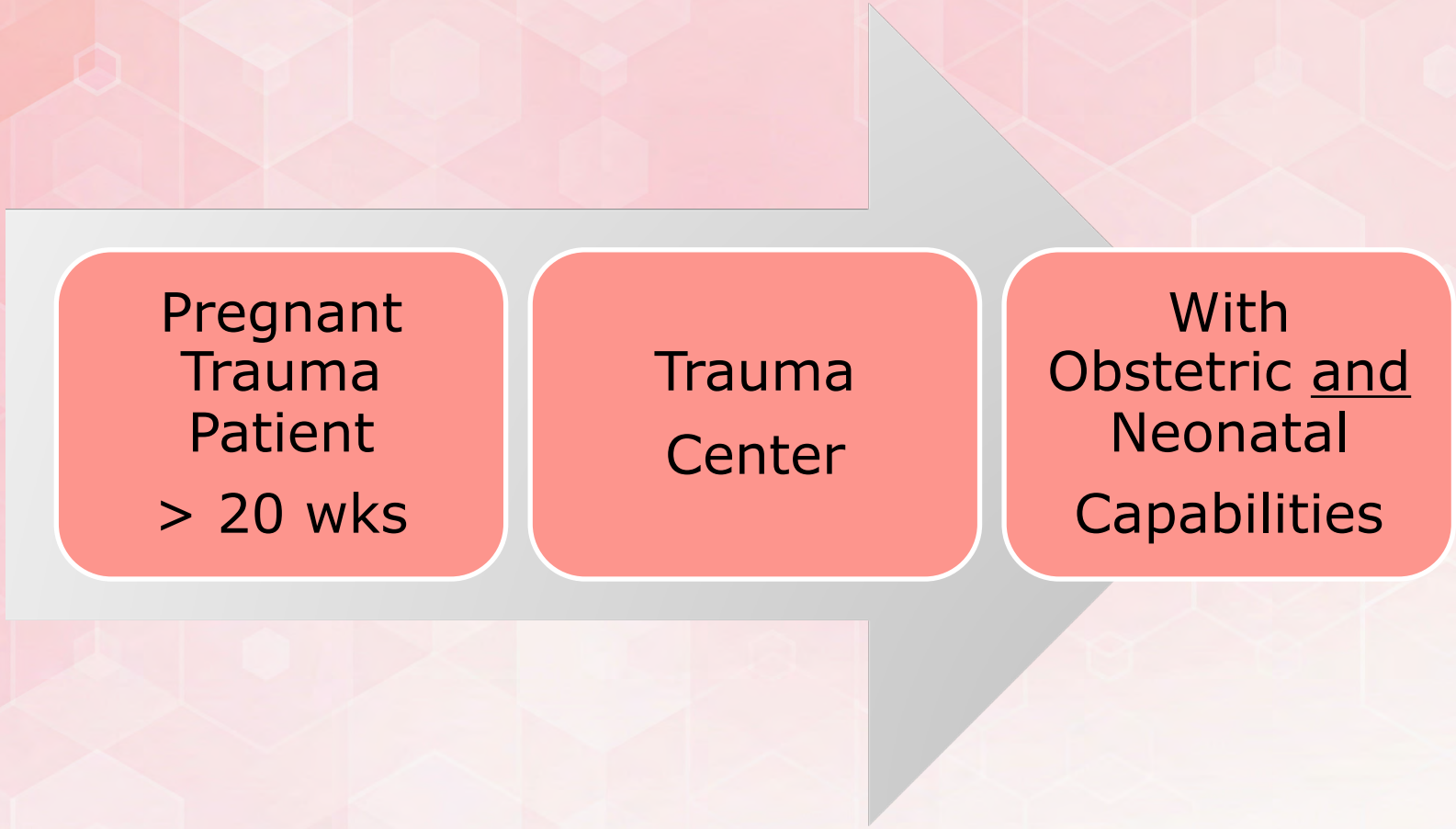
Pre-Hospital Triage



(CDC, 2012)

Initial Assessment

ATLS management

- Primary Assessment: Assess and stabilize mother FIRST
- Identify pregnancy/ gestational age
- Assess fetus after *primary* maternal assessment

(American College of Surgeons Committee on Trauma, 2012)

Primary Assessment: Airway

Resuscitation Tube Tips

- Airway edema common → difficult Intubation
  - Consider smaller ETT
- Delayed gastric emptying ↑ risk of aspiration →
  - Consider early NGT

(Mendez-Figueroa et al, 2013)

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Primary Assessment
Breathing

- Oxygen consumption is increased by mother
- Fetus is dependent on mother for oxygen delivery

- **Provide supplemental oxygen!**
- Elevated diaphragm
  - Consider higher chest tube placement

Primary Survey- Circulation

Log roll with 15-30 degree tilt or manually displace the uterus

- Optimize cardiac output while maintaining c-spine control
- Prevent compression to the inferior vena cava by displacing the uterus to the left

(American College of Surgeons Committee on Trauma, 2012)

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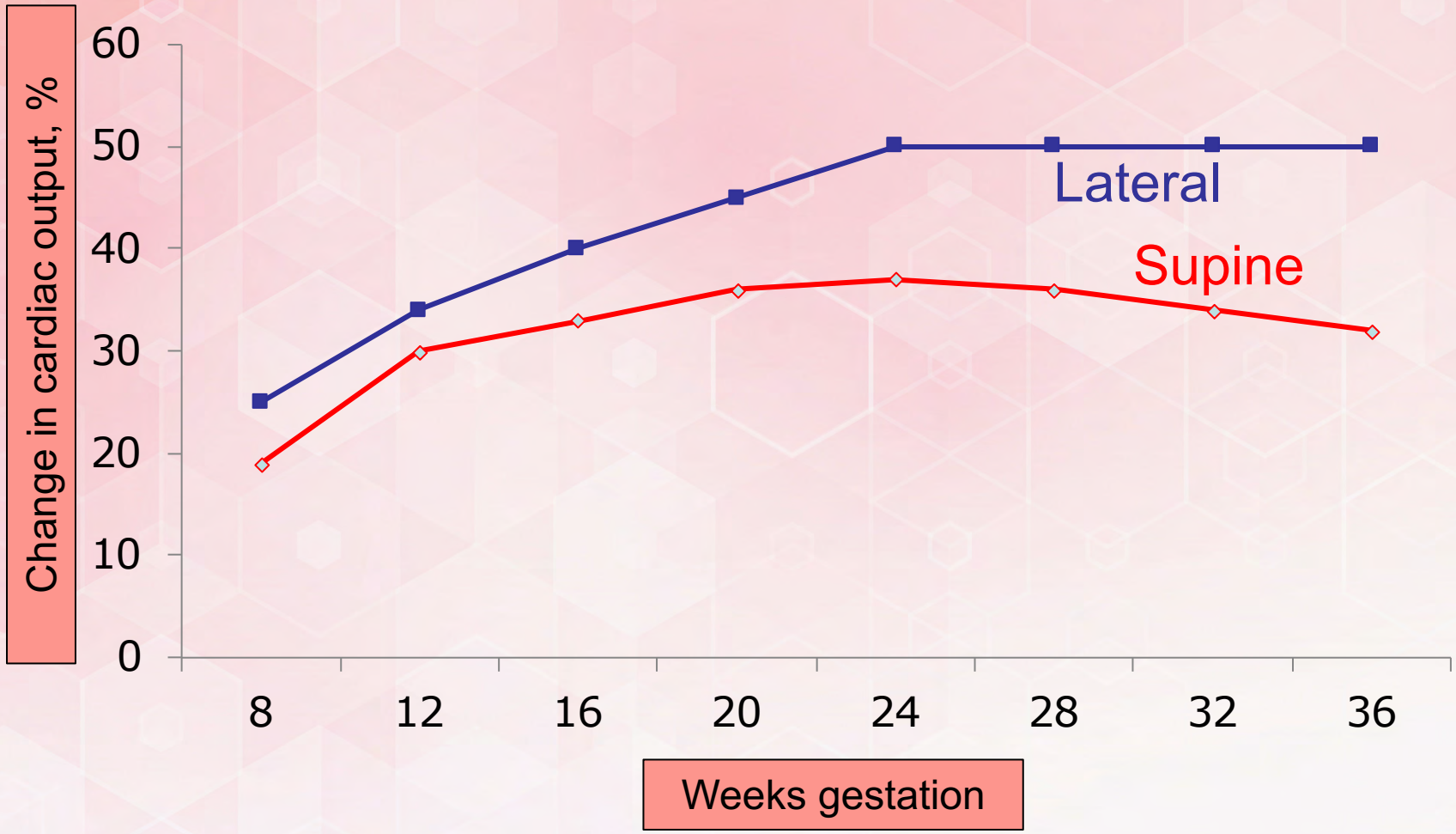
Cardiac Output in Pregnancy and Effect of Left Lateral Position



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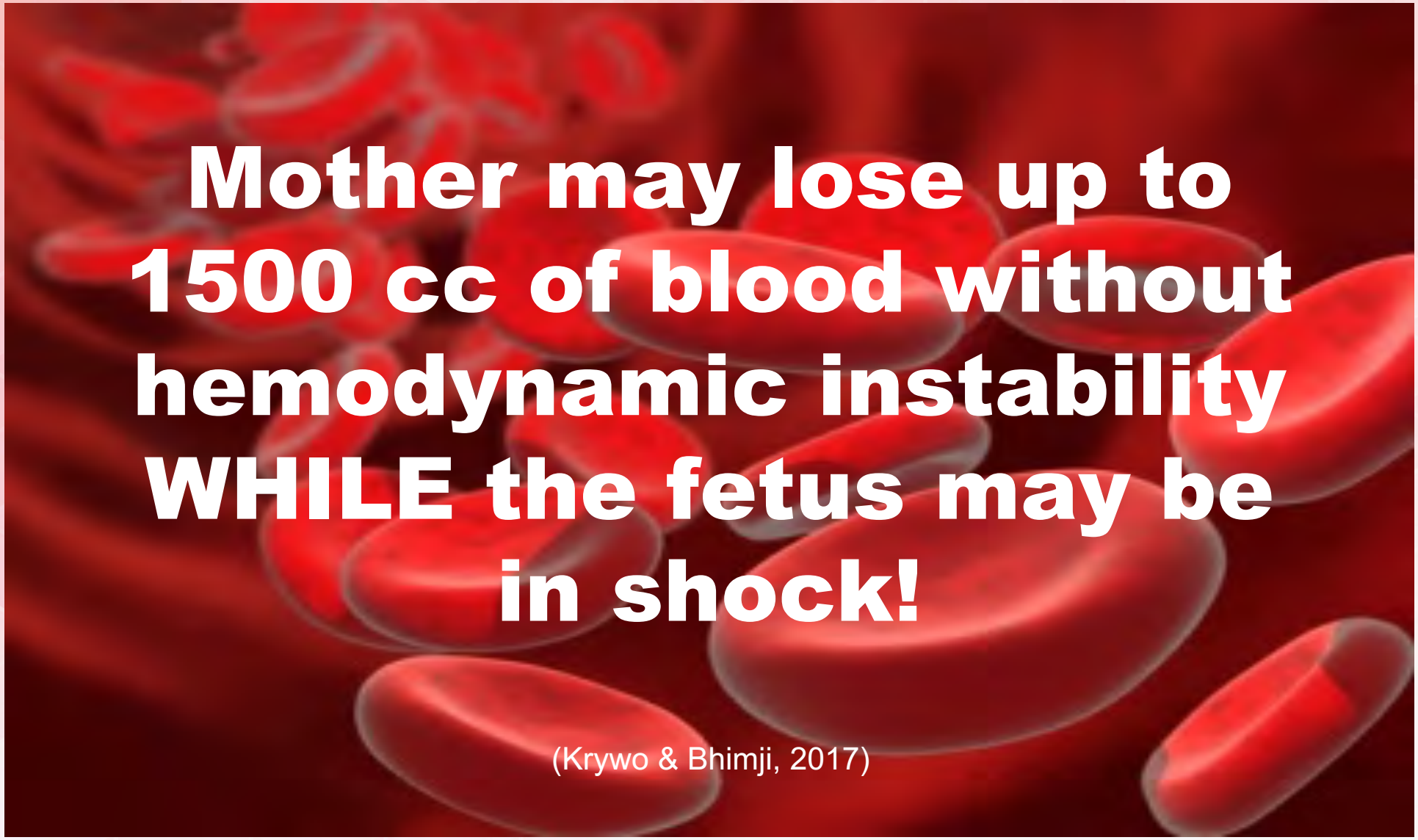
Fetal death more common than maternal death.

What is the #1 cause of fetal death in trauma?

Two Different Patients!



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Resuscitation – Maternal Shock

Adaptations to blood loss

Mild 1200-1500ml

HR 95-105, cold pale extremities, MAP 70-75mm Hg

Moderate 1500-2000ml

HR 105-120, restlessness, tissue hypoxia, MAP 50-60mm Hg, oliguria

Severe >2000ml

HR >120 hemorrhagic shock, tissue hypoxia, MAP <50mm Hg, altered LOC, anuria, DIC

(Schwaitzberg, 2015)

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Primary Survey
Circulation Interventions

- Packed red blood cells
  - Preferred over crystalloid for resuscitation
  - O negative transfusion until pt type specific available
- Vasopressors
  - Decrease blood flow to uterus and placenta
  - Use with caution

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Primary Survey Adjuncts

- Lab Studies
  - Pregnancy Test
  - Rh Factor
  - Kleihauer-Betke (KB) Test

Pregnancy Testing

- All female trauma patients of ***childbearing age*** should be considered pregnant unless proven otherwise

(Jain, Chari, Maslovitz & Farine, 2015)

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Pregnancy Test

- Serum HCG
  - Human chorionic gonadotropin (β-HCG)
  - Beneficial with decreased use of indwelling catheters
  - Quick turnaround
  - Higher sensitivity vs. urine
  - May aid in determining gestational age

Labs Specific to Pregnancy

Blood & Antibody Status

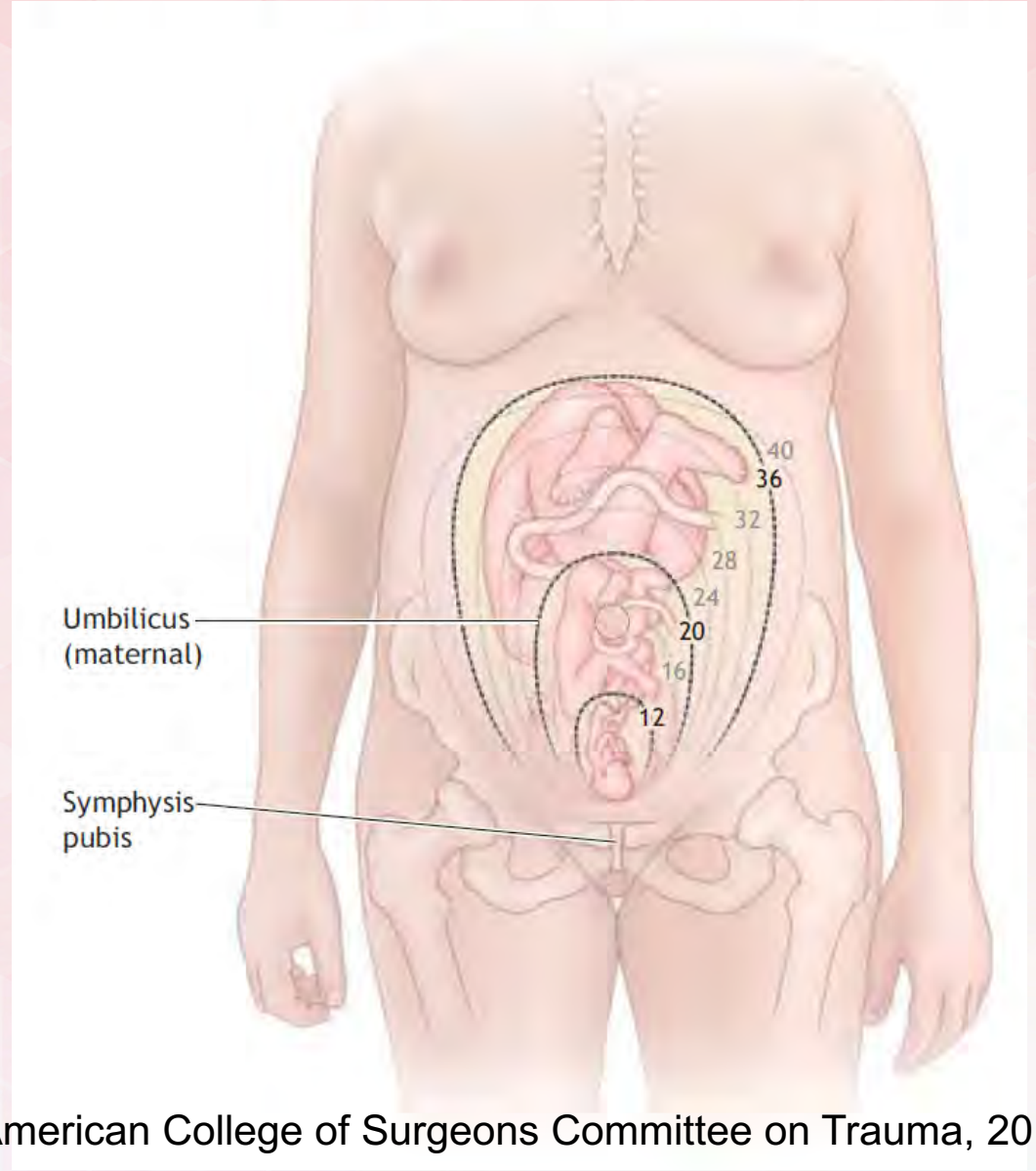
- Mother Rh neg:
  give Rh immunoglobulin therapy
- Rhogam

Kleihauer-Betke (KB) Test

- Detects feto-maternal hemorrhage
- Draw in all pregnant trauma patients
  > 12 weeks gestation
- Guides Rhogam *dosage* Rh- mothers
- No correlation between KB test and fetal outcomes

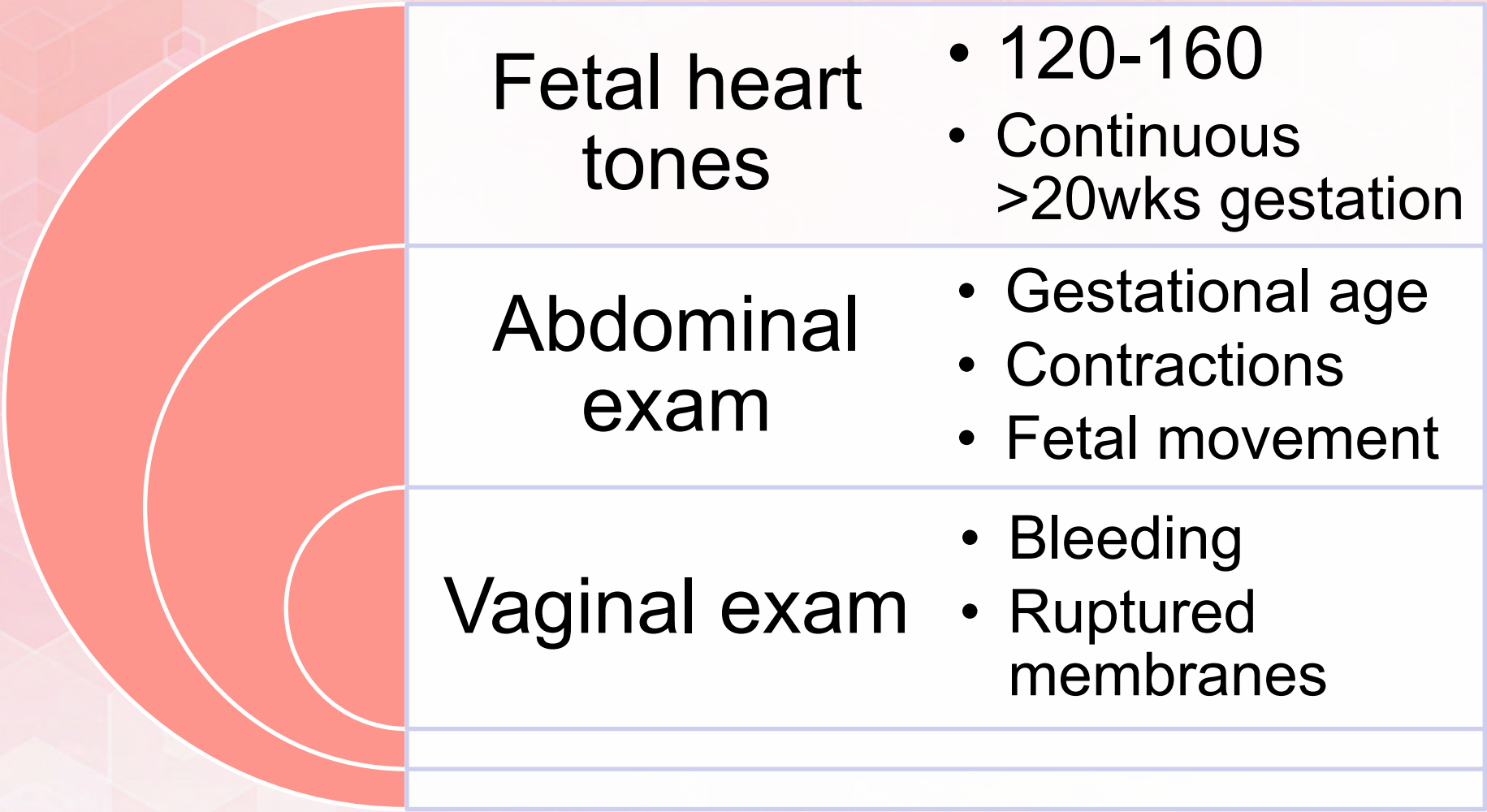
(Barraco et al, 2010; Petrone & Marini, 2015)

Estimating Gestational Age



(American College of Surgeons Committee on Trauma, 2012)

Fetal Assessment



Fetal Monitoring

- All pregnant trauma > 20 weeks' gestation
- Minimum of **6 hours** continuous fetal monitoring
- Further continuous monitoring and evaluation if any of the below is present:
  - uterine contractions
  - non-reassuring fetal heart rate pattern
  - vaginal bleeding
  - significant uterine tenderness or irritability
  - serious maternal injury
  - rupture of the amniotic membranes

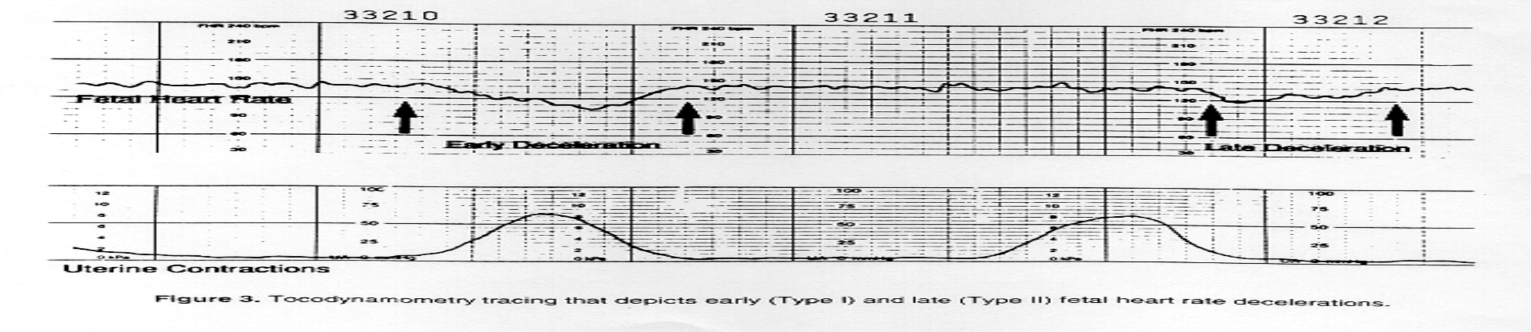


Figure 3. Tocodynamometry tracing that depicts early (Type I) and late (Type II) fetal heart rate decelerations.

(Barraco et al, 2010)

Fetal Instability

- Signs Include:
  - Bradycardia
  - Tachycardia
  - Loss of beat to beat variability
  - Decelerations
- Indication that the mother may be shunting blood away from the placenta to supply her vital organs
- May be the **first sign of impending maternal hemodynamic instability**.

Initial Assessment

- **A**irway: smaller ETT, chest tube higher
- **B**reathing: supplemental Oxygen
- **C**irculation: tilt, IV Fluids, O- blood
- **D**isability: eclampsia can mimic TBI
- **E**xposure
- **F**etal evaluation: Distress=Mother in Distress!

Secondary Survey- History

- Obtain obstetrical history:
  - Last menstrual period (LMP)
  - Due date
  - Number of fetuses
  - Pregnancy acquired issues
  - Previous pregnancies
  - Delivery history

Radiology in Trauma and Pregnancy

Benefits to the mother outweigh small risks to the fetus!

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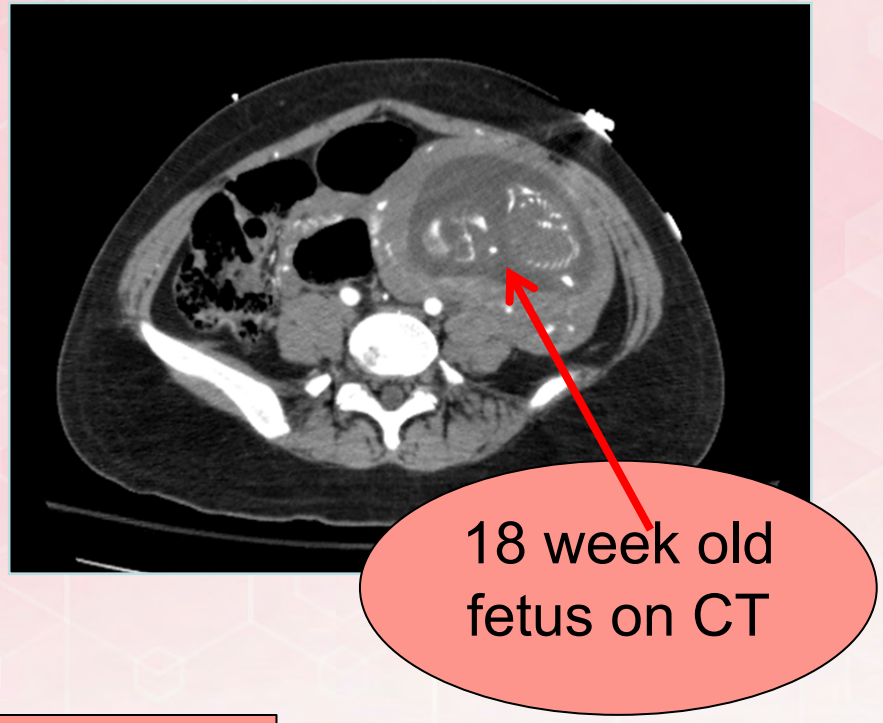
Radiologic Studies

- Ultrasound
  - Preferred test for mom & fetus
  - Not conclusive
- Plain films
  - useful
  - exposure low
- CT
  - ↑ radiation dose



No needed study should be deferred if the mother's life is at risk

(Barraco et al, 2010)

Radiologic Studies

- MRI
  - Not associated with adverse fetal effects
  - Along with ultrasounds technique of choice for the pregnant patient
  - Only use:
    - Expected to answer relevant clinical question
    - Provides medical benefit to patient
- Nuclear medicine
  - If techniques are necessary they should not be withheld from a pregnant patient

(American College of Obstetricians and Gynecologists, 2017)

Radiation Exposure Risks

Potential Effects on the fetus

- Intrauterine growth retardation
- Microcephaly
- Mental retardation
- Cancer

- Most vulnerable
  - 2 and 15 weeks gestation
- Cumulative exposure of less than 5 rads have not been shown to effect the fetus
  - CT scan abd 2.6 rad

(Roe, 2016)

Radiologic Studies

- Provide shielding when possible to the fetus
- Try to consolidate scans
- Consider other diagnostic techniques for follow-up imaging
- A missed injury could be detrimental to both the mother and fetus

Medications
FDA Pregnancy Categories

- Categories established in 1979
- Each drug was categorized using a letter based on safe use during pregnancy
  - (A, B, C, D, X)
- After June 30, 2015 medications must use a new narrative format
  - Pregnancy and Lactation Labeling Rule (PLLR)

(Department of Health and Human Services, 2014)

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Previous Medications
FDA Pregnancy Categories

Category	Risk
A	Safety established by human studies
B	Presumed safe established by animal studies
C	Uncertain safety: animal studies show risk, weigh benefits of use
D	Unsafe: human studies show risk, weigh benefits of use
X	Highly unsafe: positive evidence of harm

Medications
FDA Pregnancy Categories

Drug	Information
Etomidate	Category C- Drug does cross the placenta at term
Midazolam	Category D-Unsafe: human studies show risk, weigh benefits of use
Ketamine	Category B-Generally safe, but may cause dose-dependent increases in maternal contractions
Rocuronium/ Vecuronium	Category C-Generally safe, dose cross the placenta
Succinylcholine	Category C- Generally safe, dose NOT cross the placenta
Fentanyl/ Morphine	Category C- Drug does cross the placenta
Propofol	Category B-Drug does cross the placenta
Tranexamic Acid (TXA)	Category B- No adverse effects have been found.

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Injuries Specific to Pregnancy

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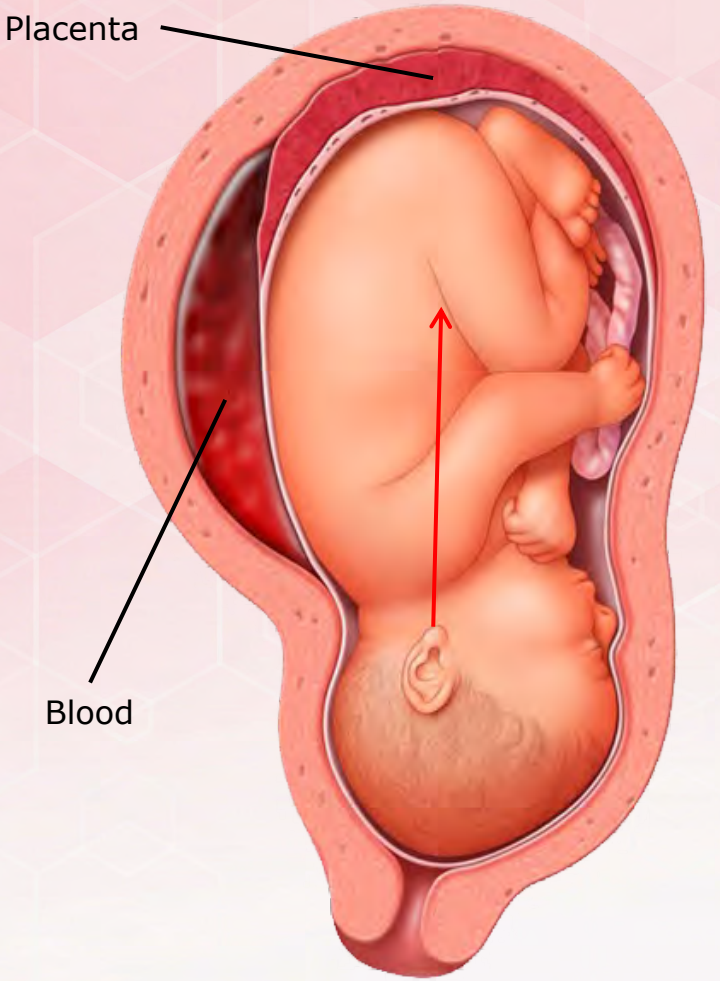
Placental Abruption

- Placental uterine separation
- Blood Loss:
  - External: vaginal bleeding
  - Occult: accumulates behind placenta



Placental Abruption

- 3 % of minor trauma
- 40% of severe trauma
- Cannot predict based on ISS

- Signs and Symptoms: rigid abdomen, abdominal tenderness, uterine contractions, fetal distress, spontaneous rupture of membranes, ***may or may not have vaginal bleeding***
- *Fetal monitoring* → *early warning system!*

(Augustin, 2014)

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Injury to the Uterus

- During pregnancy the uterine blood flow increases 10 X
  - From 60 to 600 mL/min
  - If injured => leads to rapid exsanguination
    - Causes of injury:
      - Uterine rupture
      - Uterine vessel avulsion

(Krywko & Bhimji, 2017)

Uterine Rupture

- Rare but catastrophic
- Signs and Symptoms:
  - Abdominal pain/ tenderness
  - Abdominal distention
  - Palpable fetal parts
  - Shock
  - Poor Fetal Heart Tones (FHT)
  - Guarding/Rigidity
- High maternal and fetal death

(Krywko & Bhimji, 2017)

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Direct Fetal Injury

- Rare - 1% of blunt trauma
- Maternal tissues protective for the fetus
- Fetal head injury
  - most common
- CT scan to assess fetus
- Prepare for cesarean section if indicated

3D reconstruction of 37 week fetus after MVC

(Jain, Chari, Maslovitz, &, Farine, 2015)

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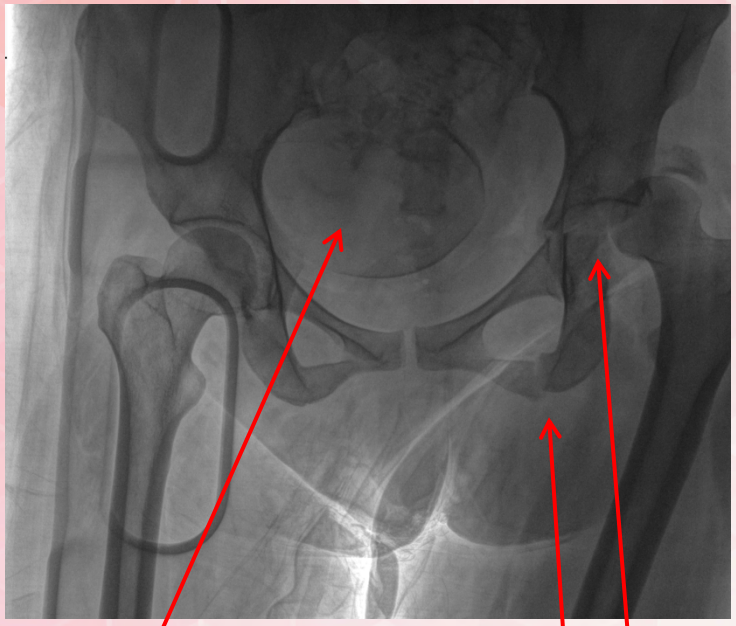
Pelvic Fractures



- Most common in MVC and falls
- Anticipate hemorrhage from engorged pelvic vessels
- Fetal mortality 35% Maternal mortality 9%
- Associated bladder or urethral trauma

(Loegters, et al, 2005)

Pelvic Fractures

- Management :
  - internal fixation
  - non-operative approach
  - pelvic binders
- Angiography & Embolization:
  - may be used with caution
- Vaginal delivery:
  - not completely contraindicated

Repair after birth by cesarean section

Penetrating Abdominal Trauma

- Uterus is the dominant organ and likely target
- Fetal demise 40-70% due to:
  - direct fetal injury and early birth
- Risk for massive hemorrhage from uterine injury

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Cardiopulmonary Arrest

- CPR:
  - ACLS principles should remain the same
- Defibrillation:
  - Little effect on fetus from electrical flow
- Perimortem Cesarean Section should be considered

(Dobiesz & Robinson, 2017)

Perimortem Cesarean Section

Indications:

- Fetus > 23 weeks gestation (age of viability)
- Reasonable certainty of maternal demise
- Knowledge of operative technique
- Available resources to resuscitate neonate
- Presence of fetal heart activity

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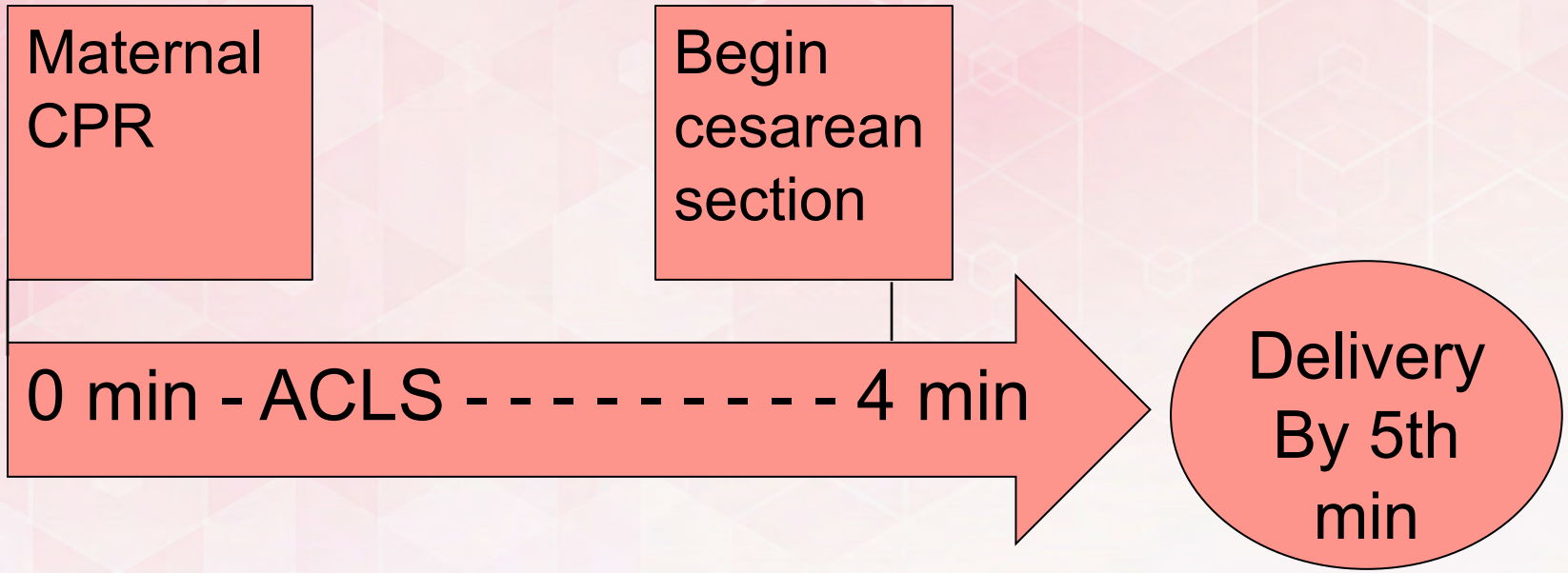
Perimortem Cesarean Section

EAST 2010 Guideline

Delivery should be carried out within 4 minutes of unsuccessful maternal arrest



(Barraco et al, 2010)

Patient and Family Support

- This event is a stressful time for both the patient and patient's family and support system
  - Listen and honor patient and family perspectives and choices
  - Share information on findings and treatment as soon as possible
  - Allow patient and caregivers to be involved in the decision making process

Family Support

- Allow visitation of support system as soon as possible
- Control pain
- Support services early (social work, chaplain)

Definitive Care
Transfer to Another Facility

- Indicated if:
  - The need of the patient(s) exceeds the resources of the current facility
- Ensure primary survey is complete and stabilized to the best of the facilities ability prior to transfer
- Transfer should be timely
- Inform patient and caregivers of need for transfer

(American College of Surgeons Committee on Trauma, 2012)

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Definitive Care
Admission: Unit Placement

- Admit to the most appropriate unit
- Matched to patients needs
- Standard of care must be maintained regardless of unit selected

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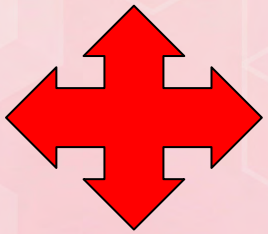
Who Admits & Where?

To Trauma ICU

- Mother severely injured & viable fetus
- Admit to trauma
- Double teamed
  - Trauma Nurse
  - L & D Nurse
  - At minimum remote continuous fetal monitoring



To Obstetric Unit

- Mother less injured, stable & viable fetus
- Initially admitted to trauma surgeon with OB on consult
- Care may be transferred to OB after 24-48 hrs

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Definitive Care
Discharge Home

- Ensure patient has appropriate follow up and prenatal care
- Complications related to trauma in pregnancy may not manifest immediately
- Pregnant patients discharged directly from the ED after minor trauma-
  - Increased risk for
    - Fetal demise
    - Low birth weight
    - Prematurity
    - Preterm Labor
    - Placental Abruption
    - Uterine Rupture

Future Considerations

- Duration of fetal monitoring
- Domestic violence screening
- Airbag safety

Summary

- A&P changes greatly impact assessment and management of the pregnant trauma patient
- Initial evaluation & treatment should focus on the mothers hemodynamic stability
- If the fetus is showing signs of distress, the mother is in distress as well
- Injury severity is not a predictor for abruption, it can occur with mild injury.
- Education regarding substance abuse, restraints, distracted driving, and domestic violence screening can save lives

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General Concepts in Pediatric Trauma Care

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Objectives

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

- Describe at least one difference in the respiratory and cardiovascular system between children and adults
- Discuss assessment of Traumatic Brain Injury in the pediatric patient
- Identify the differences in spinal, thoracic, and abdominal injuries in the pediatric patient relative to adults
- Identify physical differences and specific developmental stages for different age groups and apply assessment and intervention strategies
- Discuss at least two important considerations in the approach to victims of child abuse

Pediatric Trauma: A major threat to the health and well-being of children

- Injury is the leading cause of death among children older than 1 year
- Injury exceeds all other causes of death combined for children
- Approximately 12,000 children and teenagers die as a result of injury annually
- An estimated 9.2 million children annually had an initial emergency department visit for an unintentional injury

(Borse, et al., 2008)

Erickson's Developmental Stages

- Trust versus mistrust (birth to 2 years)
- Autonomy versus shame (2-4 years)
- Initiative versus guilt (preschool)
- Industry versus Inferiority (grade school)
- Identity versus identity diffusion (adolescence to young adult)
- Intimacy versus isolation (young adult)
- Generativity versus self-absorption (adult)
- Integrity versus despair (mature adult)

Assessment of Children

- “Quick look”
- Parental presence
- Verbal cues
- Non-verbal cues
- Compensatory mechanisms

Physical Differences in Children

that influence injury patterns and care…

- Large head and higher center of gravity
- Ligamentous laxity and incomplete fusion of vertebrae
- Bones are more compliant than an adults

Physical Differences in Children

that influence injury patterns and care…

- **Larger relative body surface area looses heat quickly**
- **Solid organs are larger compared to abdominal cavity increases risk of injury**

Vital signs, medication doses and equipment needs highly variable dependent on age/size/weight

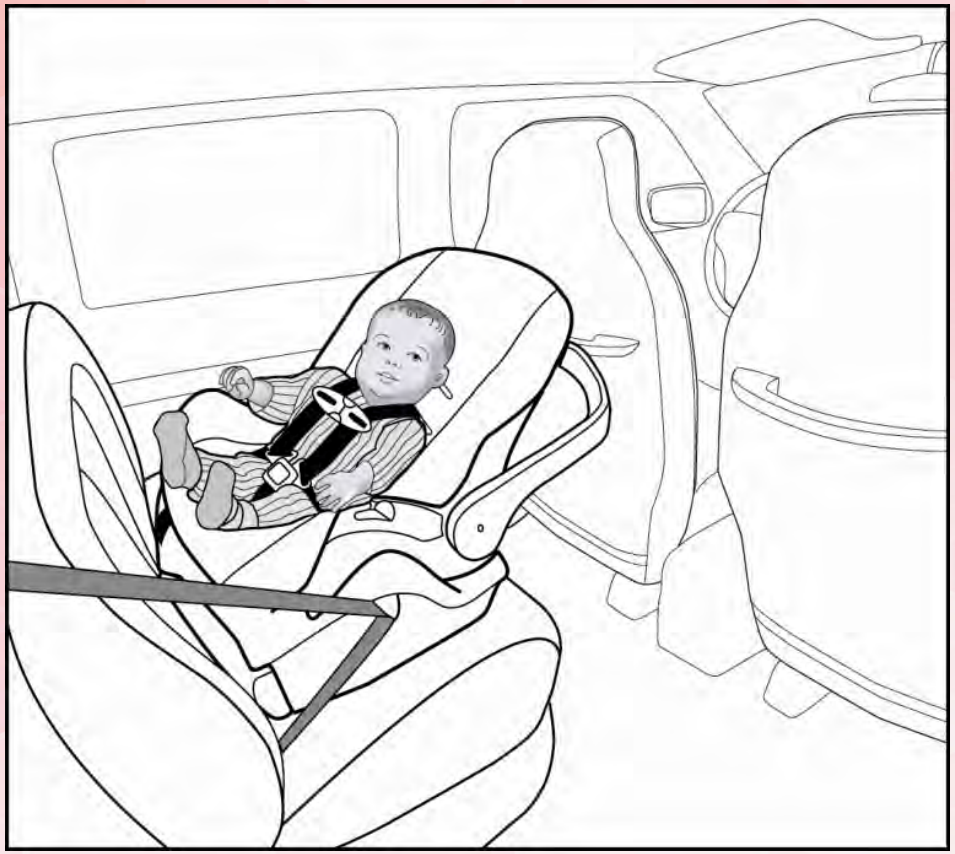
Motor Vehicle Crashes and the Pediatric Patient

- In the U.S. in 2015, 3 children were killed and an estimated 487 children were injured every day in traffic crashes
- 39% of children killed in MVC were unrestrained

Joyful designs Shutterstock.com

(National Center for Statistics and Analysis, 2017)

Improper Seating and Restraints



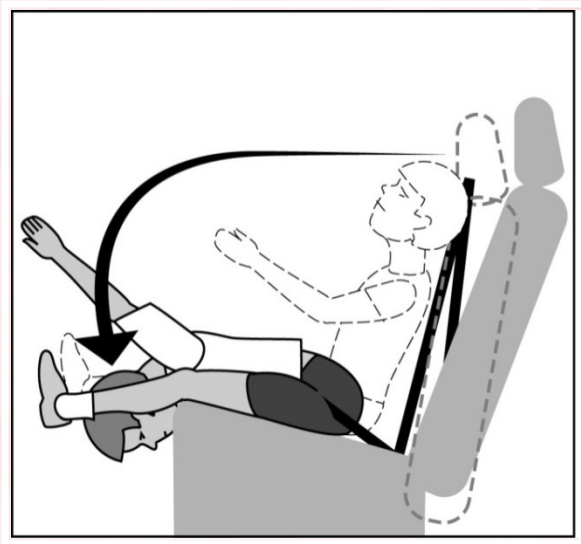
- Children need to be rear facing in the back seat until at least the age of 2 *or until they reach the highest height & weight allowed by the car seat*

(American Academy of Pediatrics, 2018)

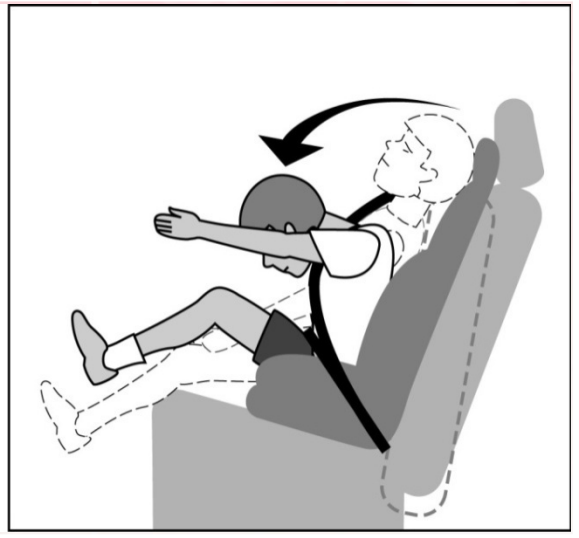
Improper Seating and Restraints

The Need for Booster Seats

- Children under 4 ft 9 inches without a booster seat tend to place the shoulder strap behind back and sit towards the front of the seat.
- The child's higher center of gravity & poorly developed iliac crests contributes to head and seat belt injuries



Child in without a booster



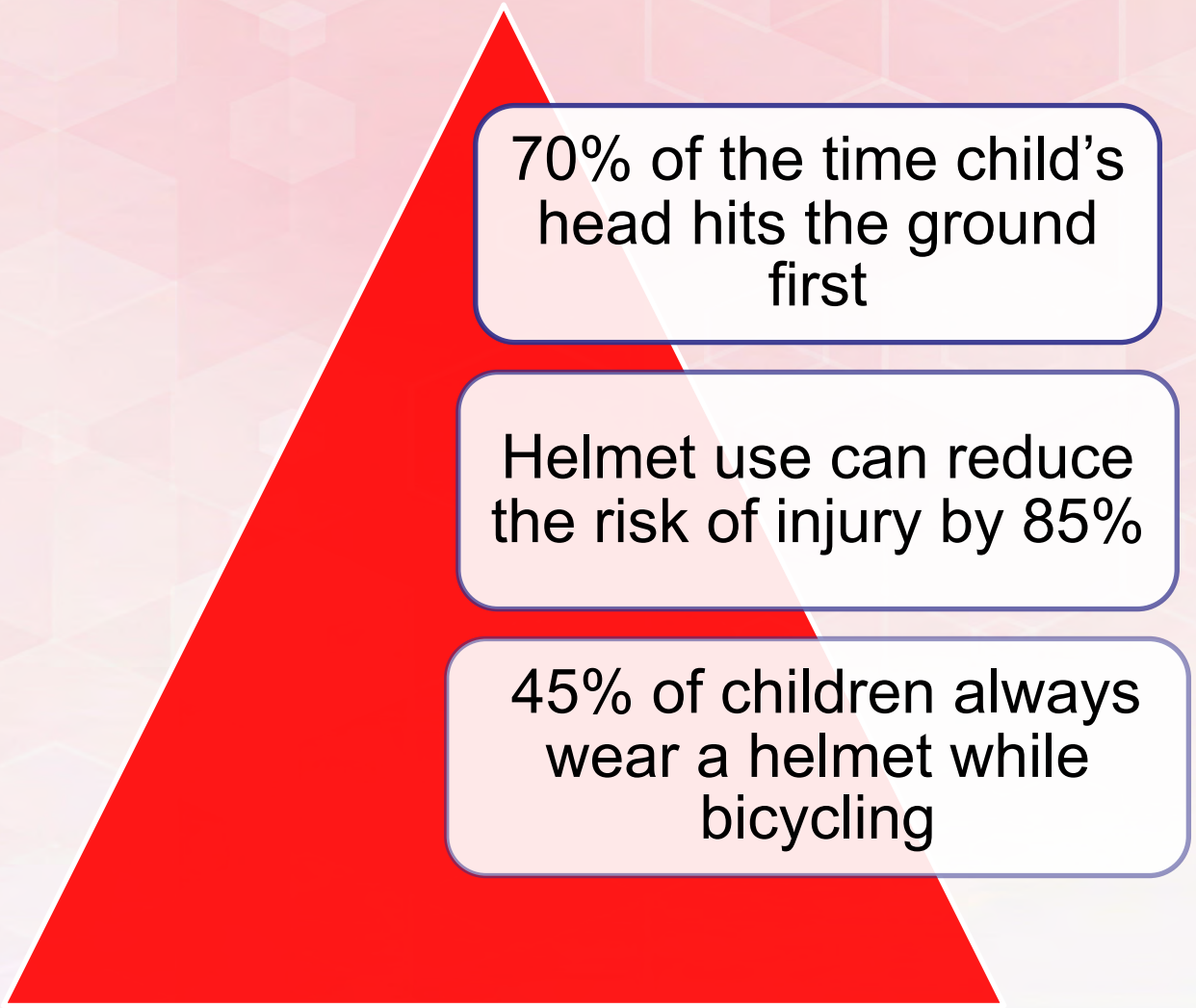
Child in a booster seat

Bicycle Crashes
Childhood Risk Factors

- 25% of all bike related deaths and 50% of all injuries occur in children between the ages of 5-14
- The crash usually takes place:
  - At non-intersections
  - Close to home/minor roads
  - Summer/late afternoons

www.safekids.org

Bicycle Crashes



Bicycle Crash Mechanisms

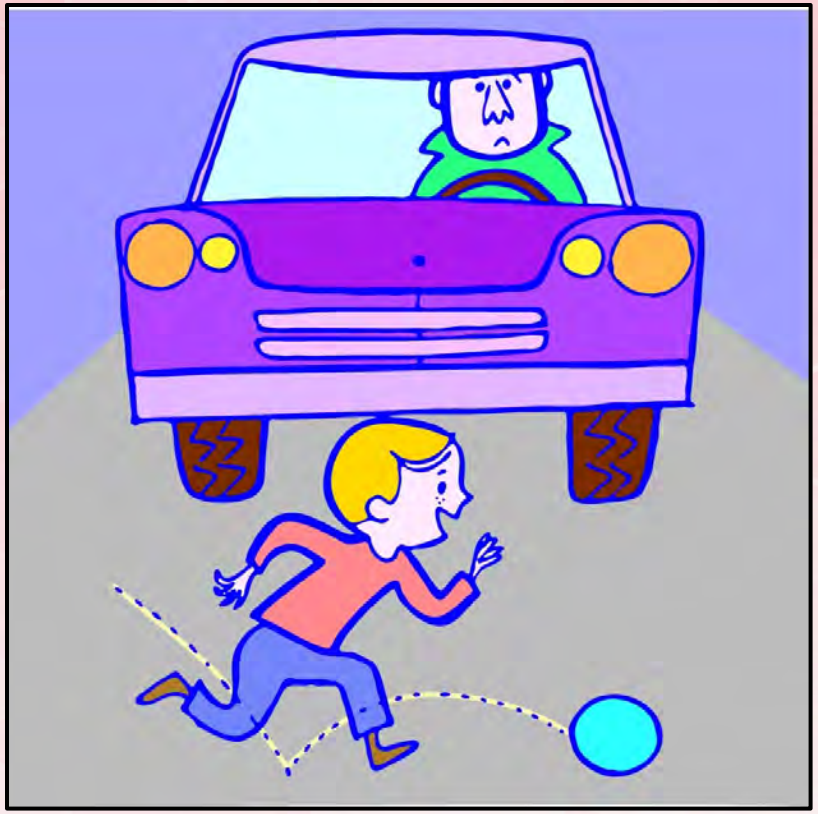
- Over the handlebars
- Collisions with motor vehicles
- Handlebar injuries

Pedestrian Injuries

- The number of pedestrian deaths and injuries in children 14 and under has decreased but in 2015 there were still 233 deaths, and an estimated 8,000 injuries in the U.S.
- Of the 233 child pedestrian fatalities, 219 were killed in single-vehicle crashes, and 14 were killed in multiple-vehicle crashes.
- 29, of the 233 child pedestrians killed were struck by a hit and run driver.

(National Highway Traffic and Safety Administration, 2017)

Waddel's Triad



- Classic pediatric injury pattern
- Vehicle impacts
  - Upper leg
  - Chest and/or abdomen
- Child is then thrown hitting head

(Waddell, 1971)

Landing Patterns Vary Between Age Groups

Birth to 2 yrs fall head first

3 to 10 years tend to fall on hands and feet

11 and older fall feet first

Traumatic Brain Injury (TBI)

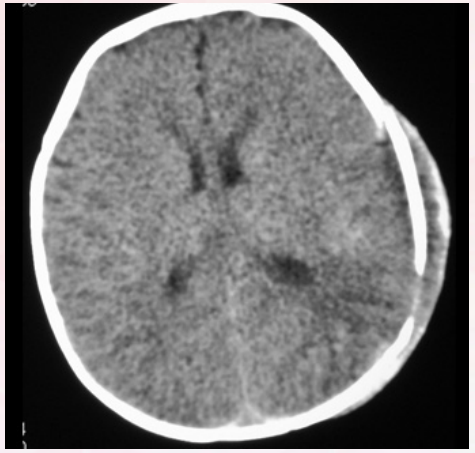
- Significant cause of death in children
  - Hypoxemia and hypotension significantly increase morbidity and mortality
- Secondary to:
  - Motor Vehicle Collisions (MVC)
  - Falls
  - Sports
  - Bicycles
  - Non-accidental trauma

Traumatic Brain Injury Classification

- **Mild (GCS 13-15)**
  - Do well; may have radiographic abnormalities
  - May have headaches, seizures, vomiting
- **Moderate (GCS 9-12)**
- **Severe (GCS 3-8)**
  - LOC, posturing, combative, abnormal neuro exam

Types of Traumatic Brain Injuries

- Epidural Hematoma
- Subdural Hematoma
- Shaken Baby Syndrome



Traumatic Brain Injuries Considerations

Pediatric Spinal Injuries

Cervical Spine

- Uncommon in younger children
- Higher risk in those > 11years
- Mortality is 15-20% usually due to secondary brain injury

Jan kranendonk Shutterstock.com

Extremity Injuries

- Incomplete calcification contributes to injury patterns
- Growth plate injury
- Strong ligaments result in fx vs. ligamentenous injury
- Fracture type determines treatment and outcomes
- Antibiotics for open fractures
- Assessment of joint above and below fracture

Thoracic Trauma

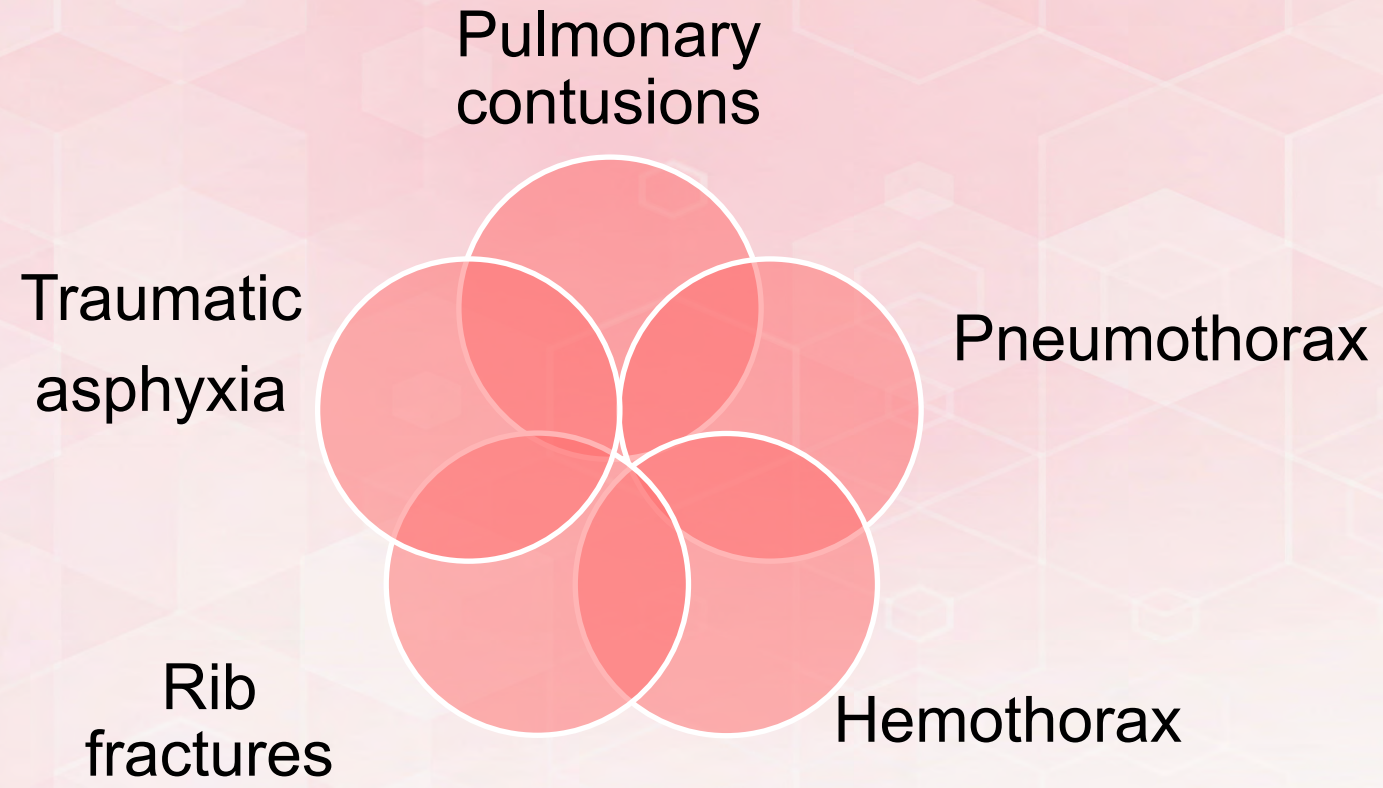
- Accounts for up to 30% of pediatric trauma admissions
- Primarily blunt mechanisms though children can have penetrating injuries form GSW or stabbing
- ~5% mortality as stand alone injury
- Mortality increases to ~25% with concomitant head or abdominal injuries and up to 40% with all 3 body regions

Why are pediatric thoracic injuries different than adult thoracic injuries?

- Smaller blood volume
- Smaller body mass
- Thorax compliance
- Gastric distention
- Concomitant injuries
- Mediastinum is not fixed
- Few require thoracotomy
- Higher metabolic demands

(Mendez, 2011; Sharma, et al., 2018)

Thoracic Injuries

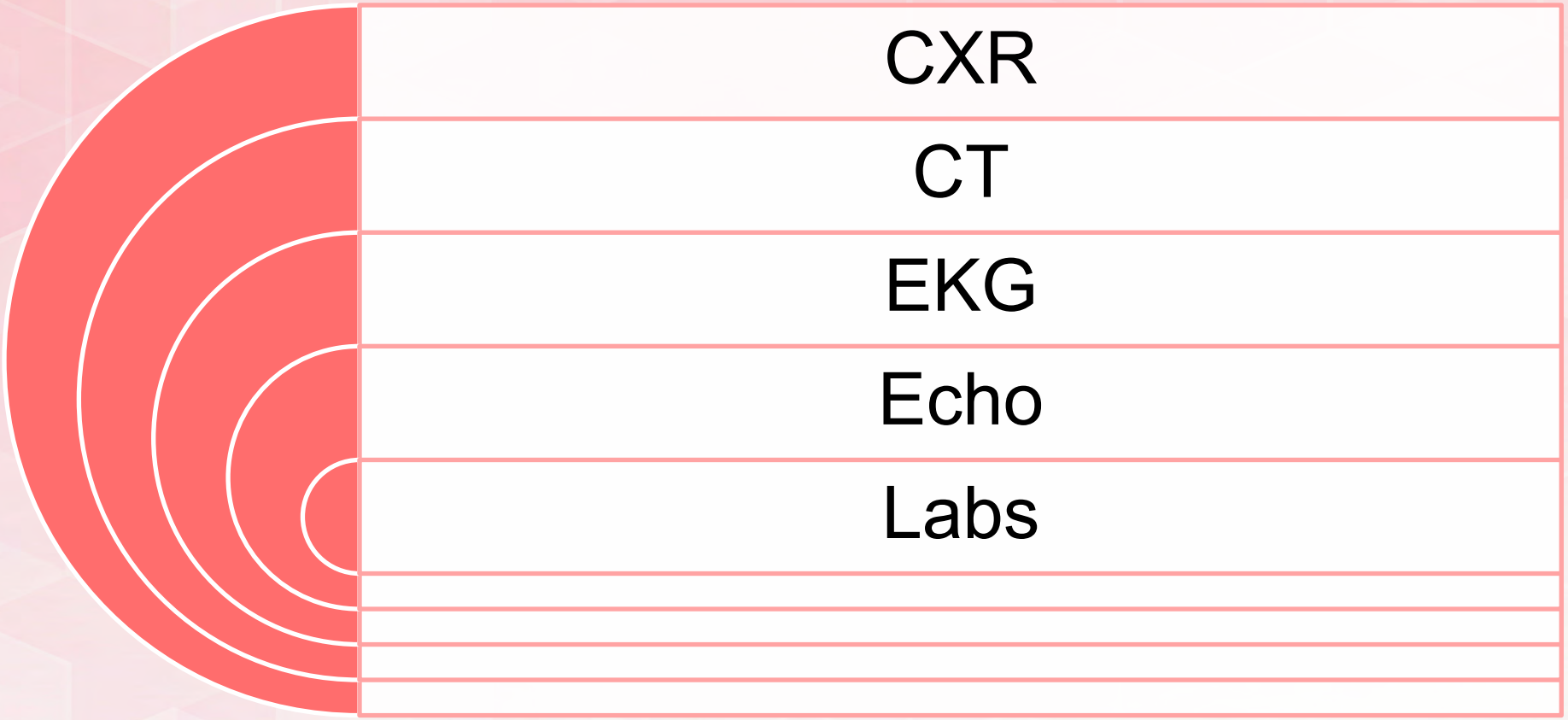


Evaluation of Thoracic Injuries

- Mechanism of Injury
- Vital sign trends
- Signs and symptoms of thoracic injury

(Eisenburg, 2017)

Diagnostics



Abdominal Trauma

- Nearly 10% of all trauma admissions
- Large majority = blunt mechanism
- Liver most commonly injured followed by small bowel, colon, stomach and spleen and kidneys

Why are pediatric abdominal injuries different than adult abdominal injuries?

- Thinner musculature
- Rib compliance
- Relative size of intra-abdominal organs
- Lower fat content
- Intestinal attachment
- Bladder position
- Hypothermia

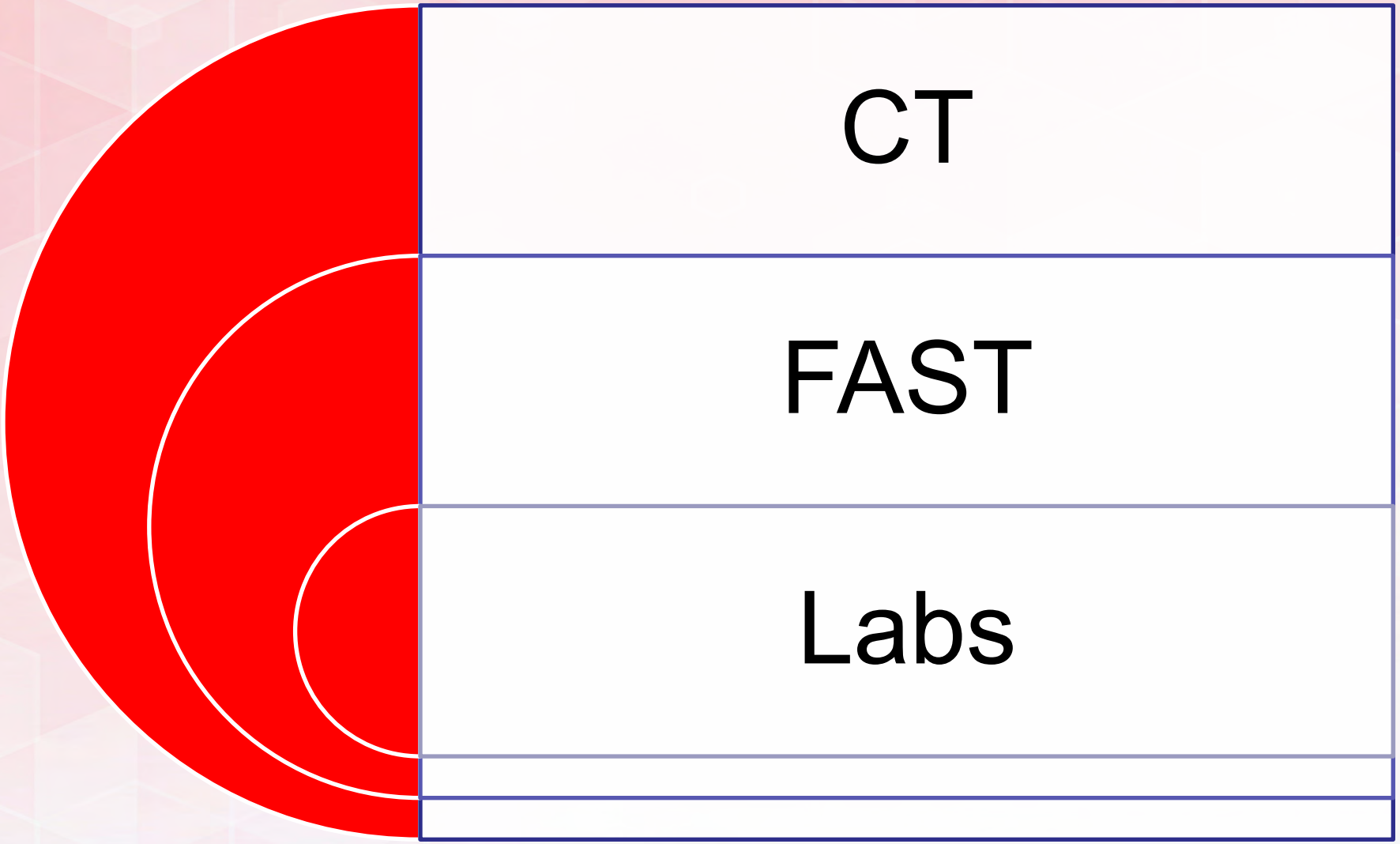
Abdominal Injuries

- Solid organ injury
- Lap belt syndrome
- Hollow organ injury

Evaluation of Abdominal Injuries

- Inspection, auscultation, palpation
- Presence of distention
- Tenderness on palpation requires further diagnostics to determine presence of injuries

Diagnostics



Resuscitation of Children

- -Airway/respiratory differences
- -Cardiovascular differences
- -Body surface area differences
- -Burn resuscitation formula

Child Abuse Considerations

- High index of suspicion
- Advocacy
- Multidisciplinary Team
- Fatality rates

(Chadwick et al. 2010)

Assessing and Treating Pain in Children

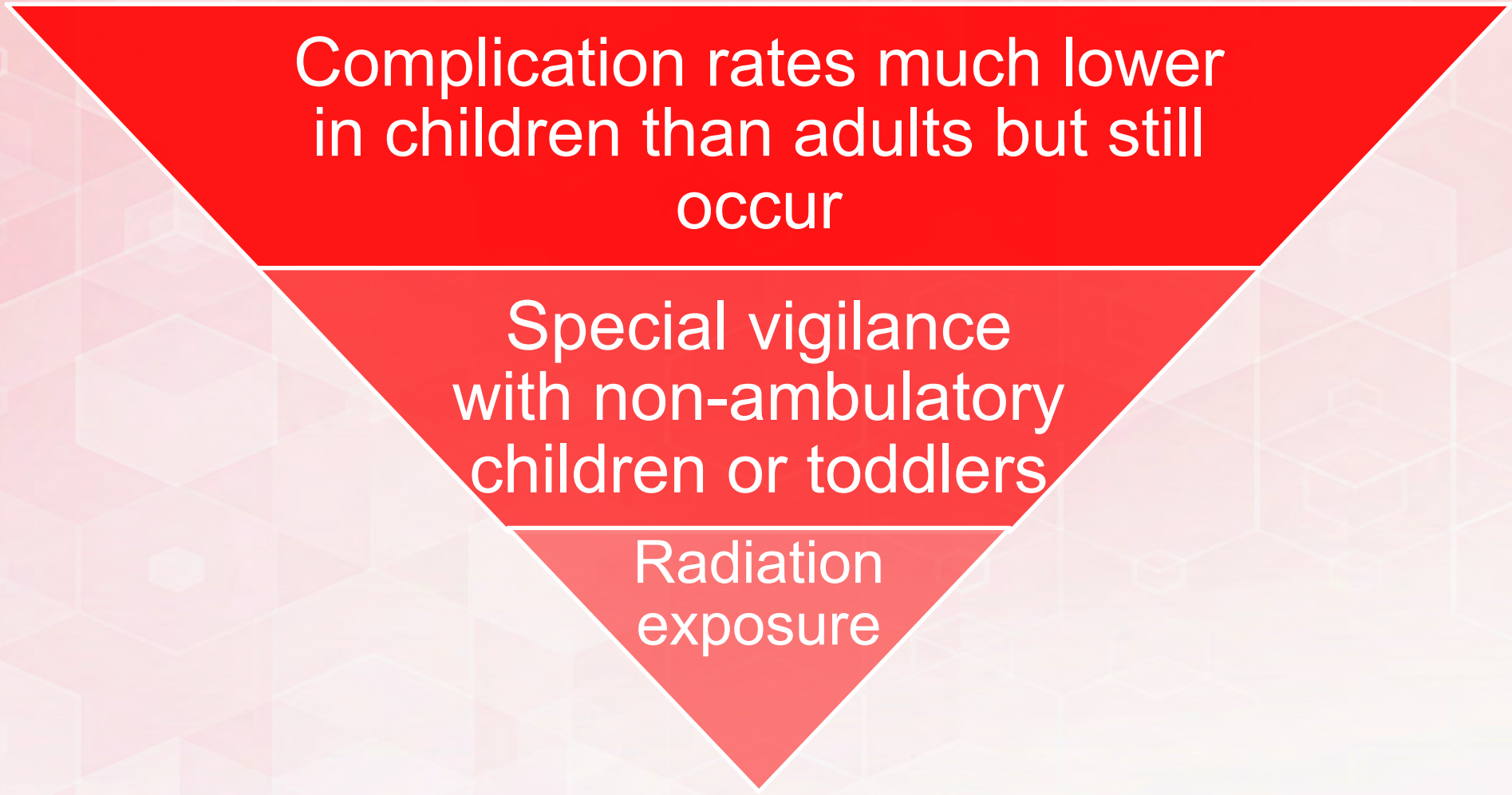
- Neonates and children experience pain and long term consequences can result from exposure to repeated painful stimuli
- Assessing pain in infants and children require special, age appropriate scales
- There are many validated pain scales available for use but an organization should select one for each specific population

Assessing and Treating Pain in Children

- Most children three years old and older can rank their pain using one of several validated tools.

Wong-Baker Faces Pain Scale

Trauma Complications in Children



(Waddell, 2018)

Transfer to Pediatric Trauma Center

- Depressed or worsening neurologic status
- Respiratory distress or failure, Intubated children
- Shock; any child requiring a blood transfusion
- Hemodynamically unstable children requiring vasopressors, ICP monitoring or invasive monitoring
- Fractures with neurovascular compromise
- Spinal cord injuries
- Traumatic amputations
- Significant MOI with associated injuries
- Whenever the primary caregiver believes the child requires specialized pediatric care

(Dowd, et al., 2018)

Transfer Considerations

- Transport Mode
- Diagnostics
- Airway, Breathing, Circulation, IV access, sedation, pain control, cervical spine immobilization
- Family centered care

Suggested Projects for Trauma Centers Caring for Children

- Development of a weight-based Massive blood transfusion protocol (MTP)
- Develop standards of care for pediatric patients involving weight in KG, IVF, and medication dosing
- Development of pediatric protocols for radiology

Summary

- Pediatric trauma care should be based upon the developmental and anatomic differences in children.
- All trauma centers should have equipment and protocols specific to pediatric resuscitation.
- Transfer to Pediatric Trauma Center when indicated.

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TRAUMA LECTURES

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Geriatric Trauma

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GREEN BAY

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
- Identify 3 factors that increase the likelihood of geriatric ground level falls
- Describe issues with pain control in the elderly
- Describe the process for rapid reversal of anticoagulants in the head injured patients

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Causes of Death – Top 10

Age 45-64 yrs

1. Malignant neoplasms
2. Diseases of heart
3. **Unintentional injuries**
4. Chronic liver disease/cirrhosis
5. Chronic lower respiratory diseases
6. Diabetes mellitus
7. Cerebrovascular diseases
8. **Suicide**
9. Septicemia
10. Nephritis, nephrotoc syndrome and nephrosis

Age 65 and over

1. Diseases of heart
2. Malignant neoplasms
3. Chronic lower respiratory diseases
4. Cerebrovascular diseases
5. Alzheimer's disease
6. Diabetes mellitus
7. **Unintentional injuries**
8. Influenza and pneumonia
9. Nephritis, nephrotic syndrome and nephrosis
10. Septicemia

(Kochanek KD, Murphy SL, Xu JQ, Tejada-Vera B., 2016)

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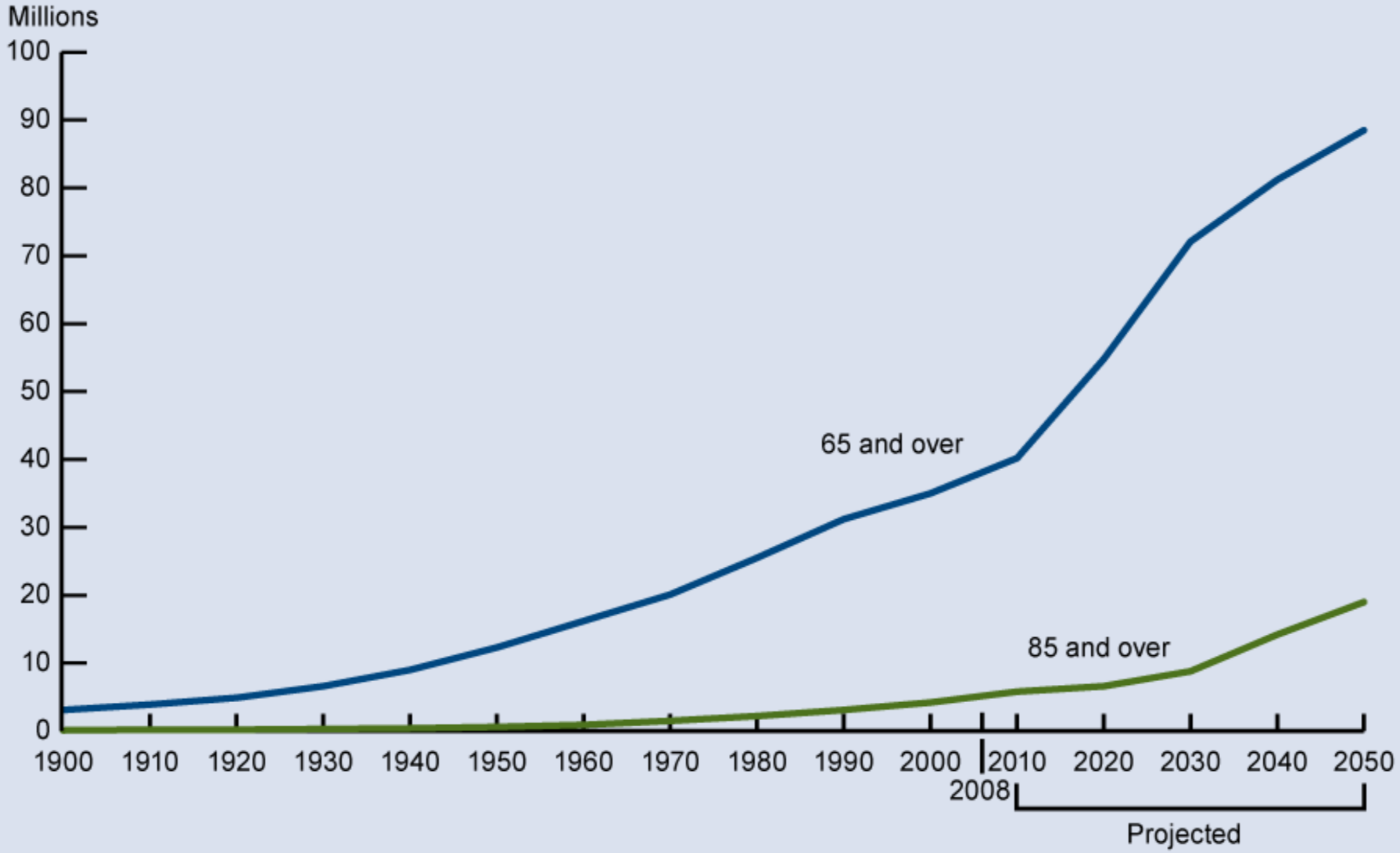
Epidemiology

- Average American life span has increased by 31 years in the past century
  - 1900's = 47 year old
  - 2015 = 78 years old (both genders)
- Percent US population age >=65
  - 2016 = 15.2% (estimated July 1, 2016)
  - By 2050 = > 20%

(National Center for Health Statistics, 2017)

Population age 65 and over and age 85 and over, selected years 1900–2008 and projected 2010–2050



NOTE: Data for 2010–2050 are projections of the population.
Reference population: These data refer to the resident population.
SOURCE: U.S. Census Bureau, Decennial Census, Population Estimates and Projections.

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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 ….???

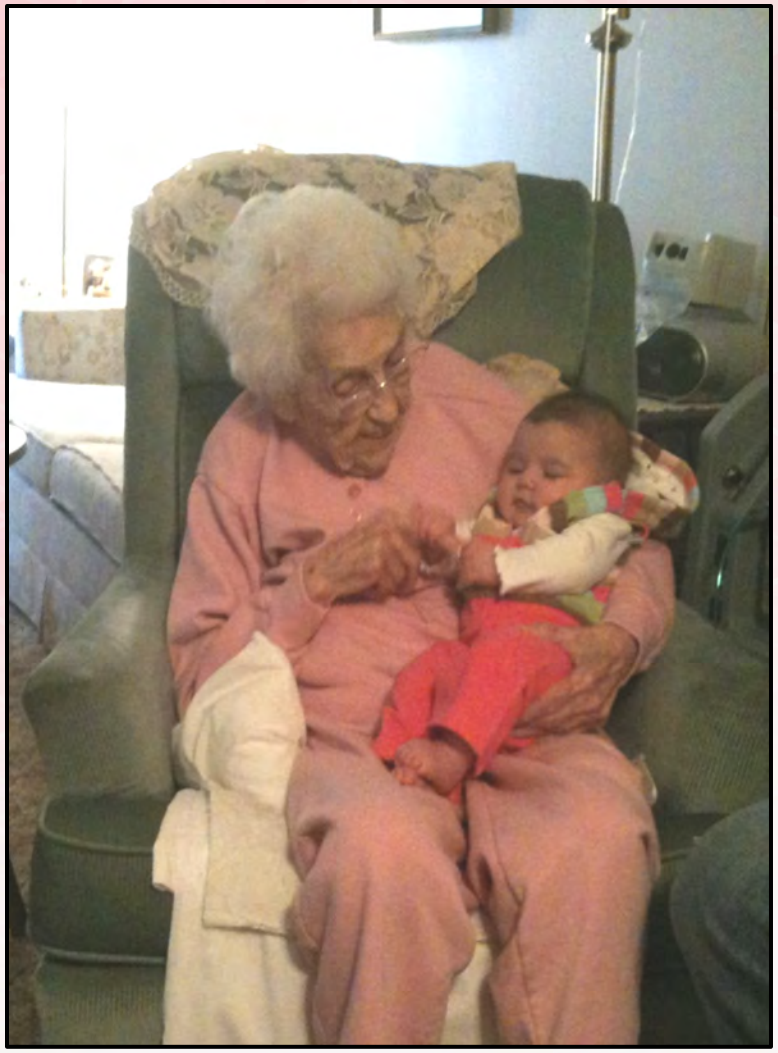
What is Geriatric?

Age ≥ 65
- the classic retirement age

Age ≥ 70
- geriatric trauma definition
- based upon stratification of injury survival and age

Age ≥ 75 - 80
- Geriatrician's view

Physiologic age
- More importance than chronologic age



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Most Common Mechanisms of Unintentional Injury

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

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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

One out of four people 65 and older fall each year

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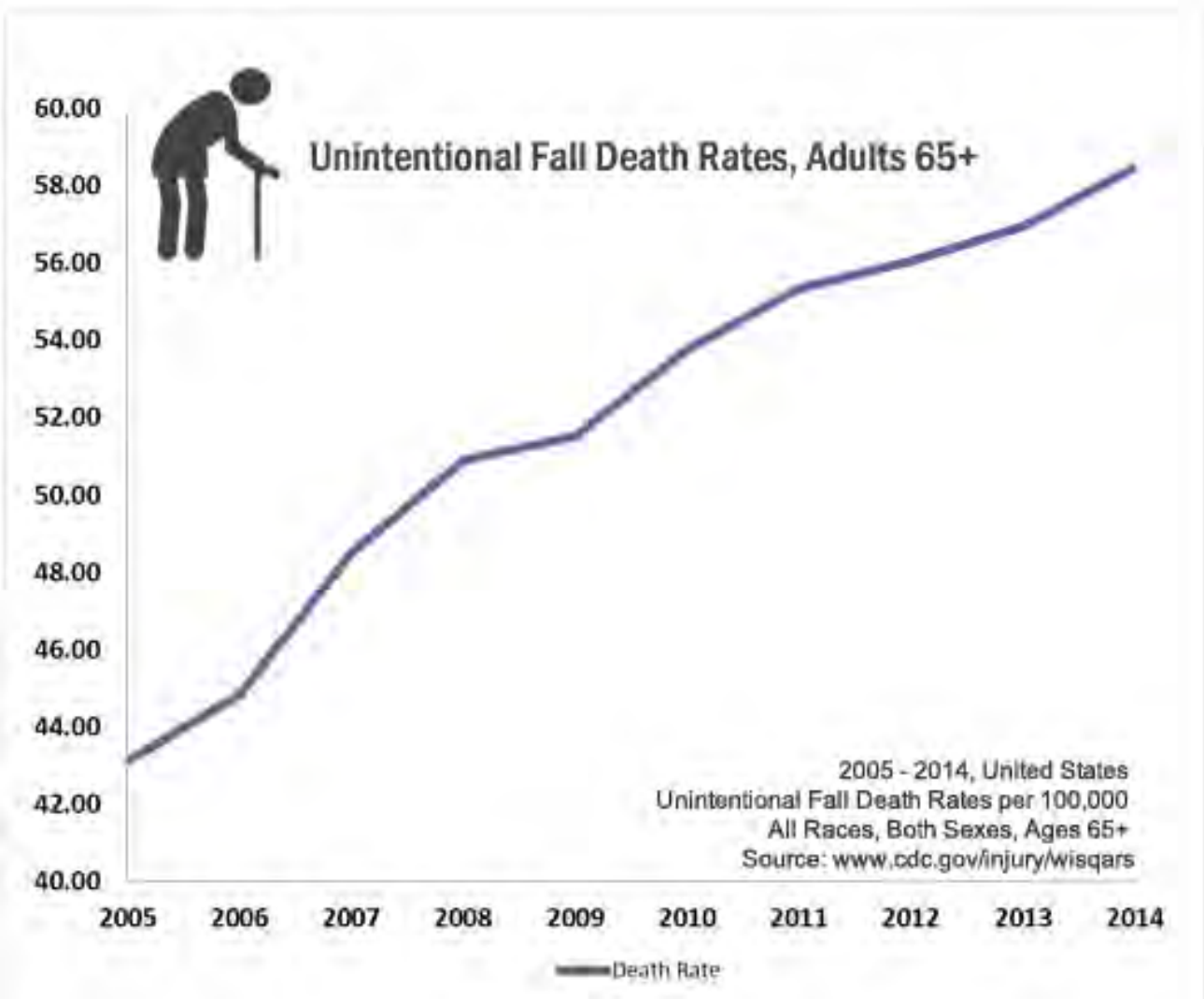
Elderly Falls to 2014



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Risk Factors in Falls

Intrinsic

- Advanced age
- History of previous falls
- Muscle weakness
- Gait/Balance problems
- Vision problems
- Postural hypotension
- Chronic conditions (arthritis, stroke, dementia, etc)
- Fear of falling

Extrinsic

- Lack of stair handrails
- Poor stair design
- Lack of bathroom grab bars
- Dim light or glare
- Obstacles & tripping hazards
- Slippery or uneven surfaces
- Psychoactive medication
- Improper use of assistive devices

(Centers for Disease Control, 2017)

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Medications most likely to cause falls

- Anticonvulsants
- Antidepressants
- Antipsychotics
- Benzodiazepines
- Opioids
- Sedative-hypnotics
- Anticholinergics
- Antihistamines

(Centers for Disease Control, 2017)

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What Intrinsic/Extrinsic Risk Factors can be modified?

Factor	Intervention
• Weakness, poor balance	• Repletion of Vitamin D • Falls prevention exercise program • Assistive device
• Difficulties with walking/balance	
• At risk medication • Vision problems	• Medication assessment and “pruning” • Eliminate bifocals and progressive lenses

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What Intrinsic/Extrinsic Risk Factors can be modified?

Factor

- Foot pain or poor footwear
- Environmental hazards

Intervention

- Assess footwear/recommend appropriate
- Eliminate “slippers”
- Railings on stairways
- Eliminate throw rugs
- Adequate lighting at night

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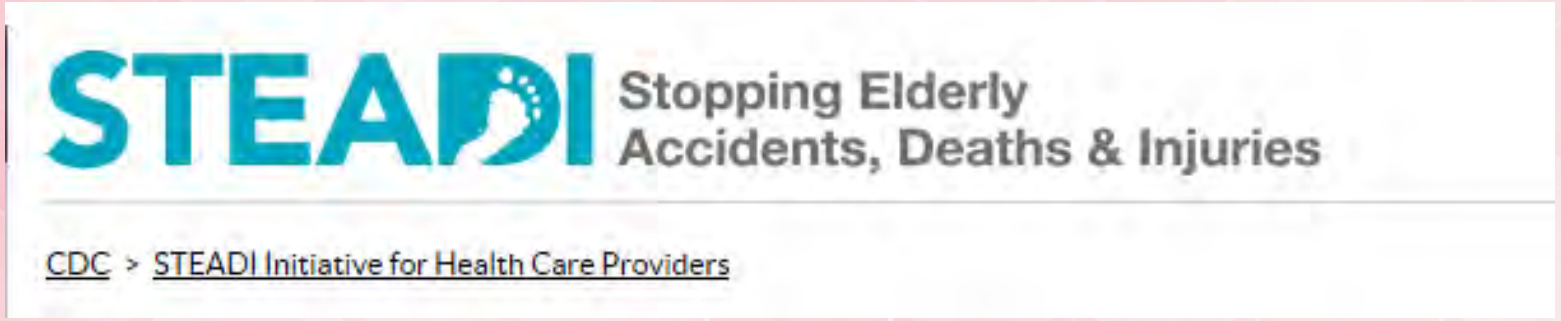
Resources



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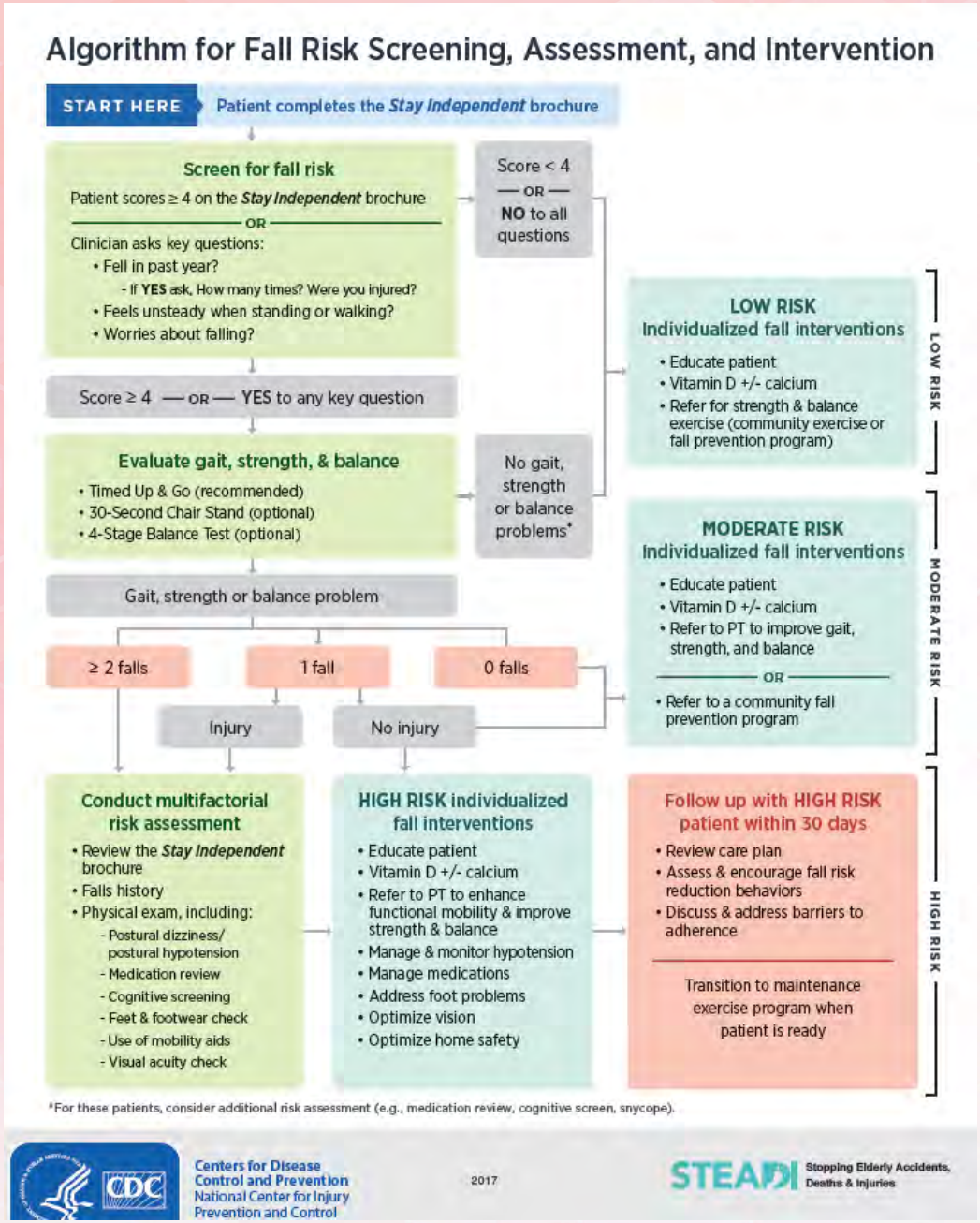

Most current, evidenced-Based fall assessment tool

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Motor Vehicle Crashes

(Department of Transportation, 2015)

2nd most common cause of unintentional injury in the elderly

Older adults (>65):

- 18% of all drivers
- 16% of all traffic fatalities
- 8% of all injuries

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Motor Vehicle Crashes

- Each day, on average,16 older adults are killed and 648 are injured in crashes every day
- 40 million licensed older drivers in 2015
- 50% increase in number of older drivers since 1999

(Insurance Information Institute, 2017)

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How do crashes involving older drivers differ from crashes of other drivers?

- Angle crashes
- Overtaking/merging
- Multiple vehicle crashes account for 40% in drivers 80 years and older
- Failure to yield right-of-way
- Failure to look both ways or not seeing

(Insurance Institute for Highway Safety, 2017)

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Why these common patterns?

- Older adult were half as likely to execute secondary glances as middle aged drivers in intersections
- Tend to look in front of vehicle rather than sides
- Increased difficulties with large head movements, psychomotor coordination, multitasking, scanning complex intersections; vision

(Yamani, 2018)

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

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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

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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

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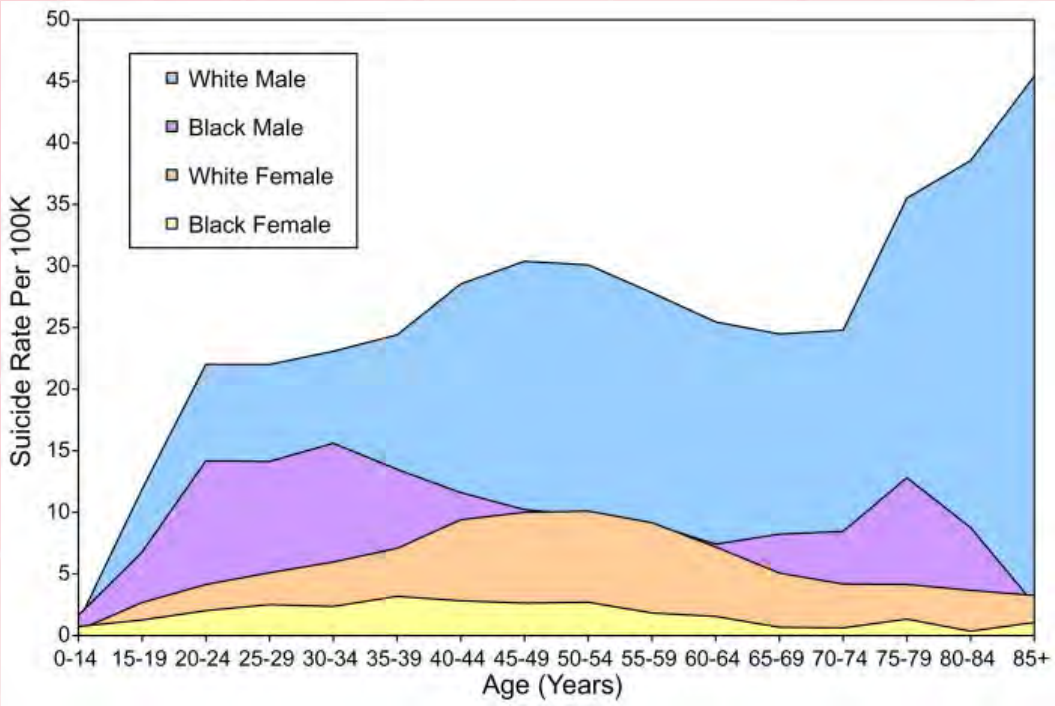
Suicide

- Males > 75 Highest Rate of Suicide in the U.S.
- Risk Factors
  - Psych illness
  - Decrease social connectedness
  - Physical illness/incapacity



(Conwell, 2011)

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Co-morbidities

- 36% of elderly trauma patients:
  - pre-existing disease
- Worst outcomes noted with:
  - Chronic Heart Disease
  - Cancer/blood disorders

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Unique Anatomic and Physiologic Considerations in Geriatric Trauma

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Sensory Considerations

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

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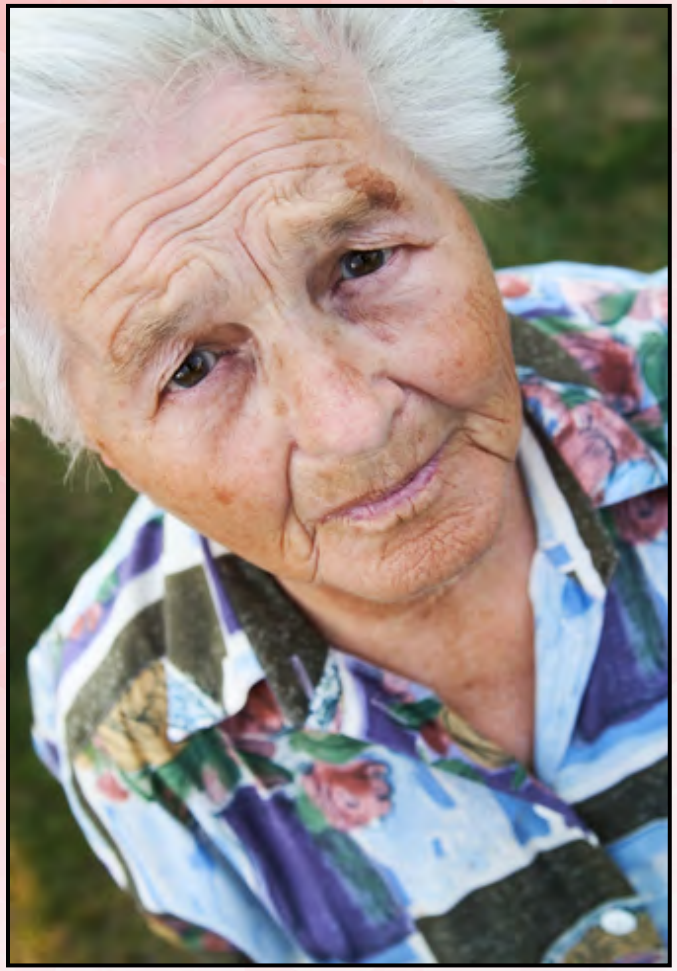
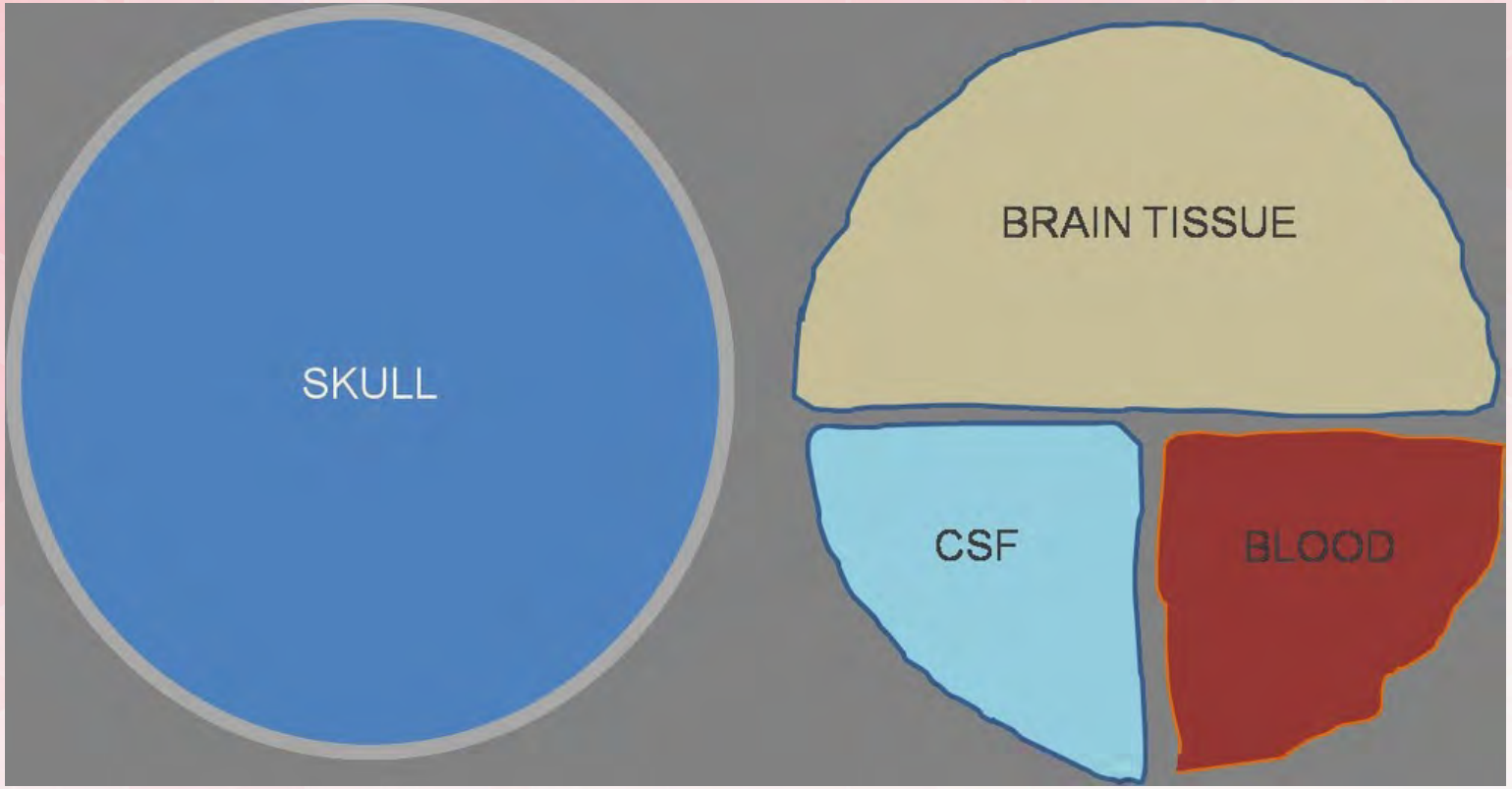
Neurologic Considerations



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

Neurologic Considerations:
Parenchymal volume of the Elderly patient: Monro-Kellie Hypothesis



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The Older Brain: Sometimes less parenchyma- accommodates large volume of blood

Pharmacology and Older Adults

- Study of 2016 community-dwelling older adult
  - 87% used at least 1 prescription drug
  - 36% used 5 or more

(Qato et al, 2016)

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Pharmaceutical Considerations in Trauma

- Start Low and Go Slow with anything (pain meds, etc.)
- BEERS criteria – drugs to avoid
- Available from the American Geriatrics Society
- Common side effects:
  - Constipation
  - balance issues
  - postural hypotension

(Campaneli, 2012)

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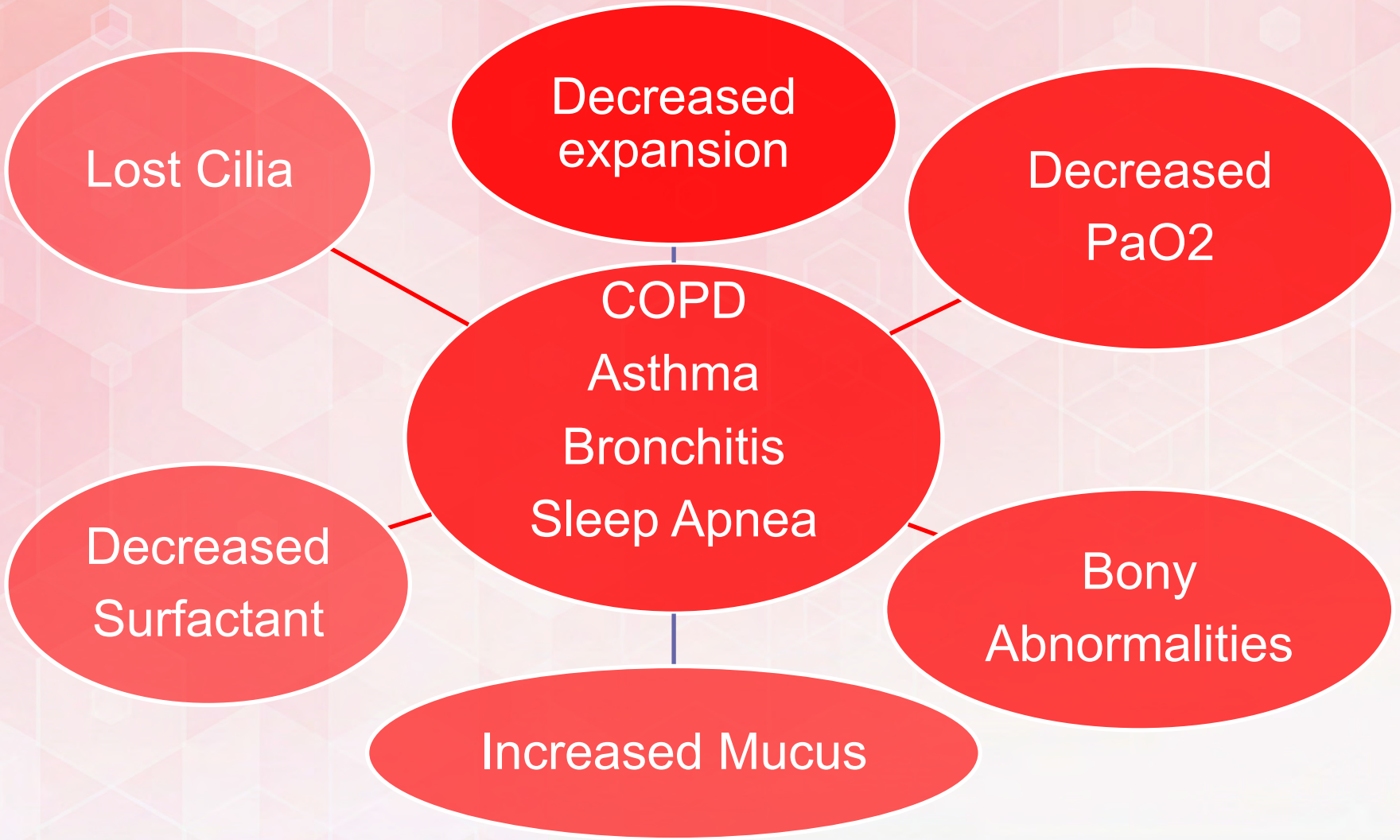
Pulmonary Considerations



Renal Considerations

- Renal blood flow decreases 10% per decade
- Steady decline in functioning nephrons leads to

Reduced ability to filter & clear drugs

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Renal Considerations (continued)

Caution:

Even with normal kidneys:

- hypotension,
- hypovolemia,
- acute kidney injury from IV contrast
- pharmaceuticals (ACE, NSAIDS, etc.)
- rhabdomyolysis.

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Causes of Hospital Acquired Renal Failure

1. Surgery
2. Hypotension
3. Contrast Induced Nephropathy

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GI Considerations

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

Musculoskeletal Considerations

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

Compression Fractures

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Chin-On-Chest Deformity- Trauma Patient with Ankylosing Spondylitis: The IMPOSSIBLE AIRWAY

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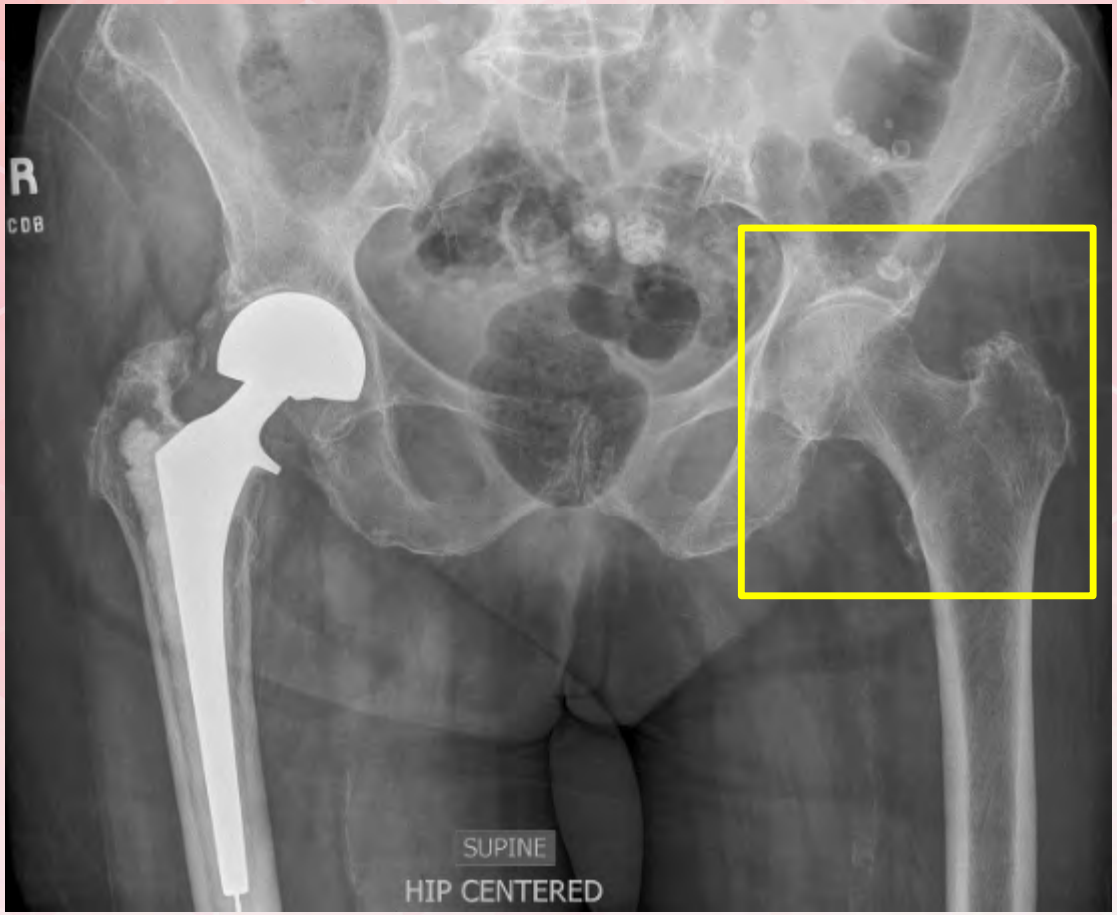
Ankylosing Spondylitis

- Spine deformity
  - Progressive kyphosis
    - Anterior vertebral height loss
    - Intervertebral disc wedging
    - Decreased mobility
      - Limits compensatory extension

Intertrochanteric Fracture

82 year old woman who had a ground level fall – presented complaining of left hip and pelvis pain.



No evidence of fracture in left hip. "severe diffuse bony demineralization"

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Typical Clinical presentation of patients with hip fracture

- History of ground level fall
- Pain in the groin area/hip
- Inability to bear weight
- On physical exam, shortened leg
- Pain on axial loading and motion

Hip Fracture Risk Factors

- Due to Osteoporosis
  - Age over 70 years old
  - Chronic steroid use
  - ETOH abuse
  - Inactive, state of declining health (i.e. bed rest)

Imaging choices in occult hip fracture.

- The gold standard test for 95% of hip fractures is plain x-ray
- The gold standard for 5% of occult hip fractures is an MRI.

(Cannon et al., 2009)

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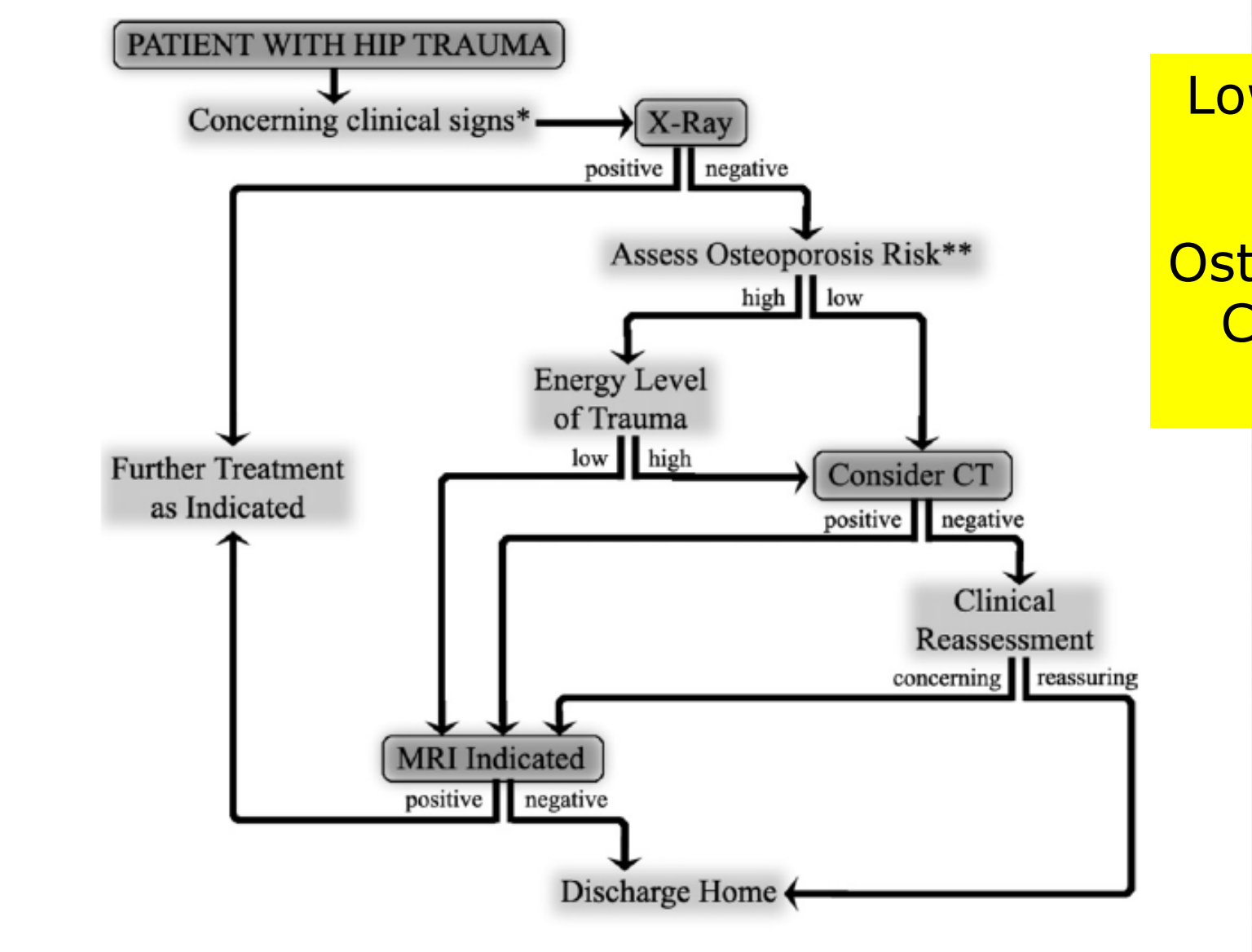
MRI diagnosis of occult hip fracture
Imaging choices in occult hip fracture.

In the ***first hours*** after fracture, T1 images show low-density dark bands.

After a ***24 hours*** fracture sites develop edema visualized with T2 images.

(Cannon et al., 2009)

Algorithm for work up in ED of hip pain patient



Low energy

+

Osteoporosis

Calls for MRI

(Cannon, 2009)

Conclusion for the Resuscitation Nurse?

- About 5% of hip fractures cannot be seen on plain films and CT
- If the elderly patient still has hip pain on mobilization, MRI might be required

Musculoskeletal Implications

- Early mobility
- Early PT
- Early Rehab

Endocrine Considerations

- Increase in glucose tolerance
- Hypothyroidism
- Menopause

- Continue supplements
- Monitor glucose

Cardiovascular Considerations

Primary Concern:

- Limited cardiac reserve
- Unable to increase O2 delivery to meet demands

In the Presence of:

- Previous MI
- Heart Failure
- Beta blockers
- Bradyarrhythmias
- Loss of atrial kick

More CV considerations

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

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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

Crystalloid Resuscitation in Elderly

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

Unique Situations Impacting Care

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

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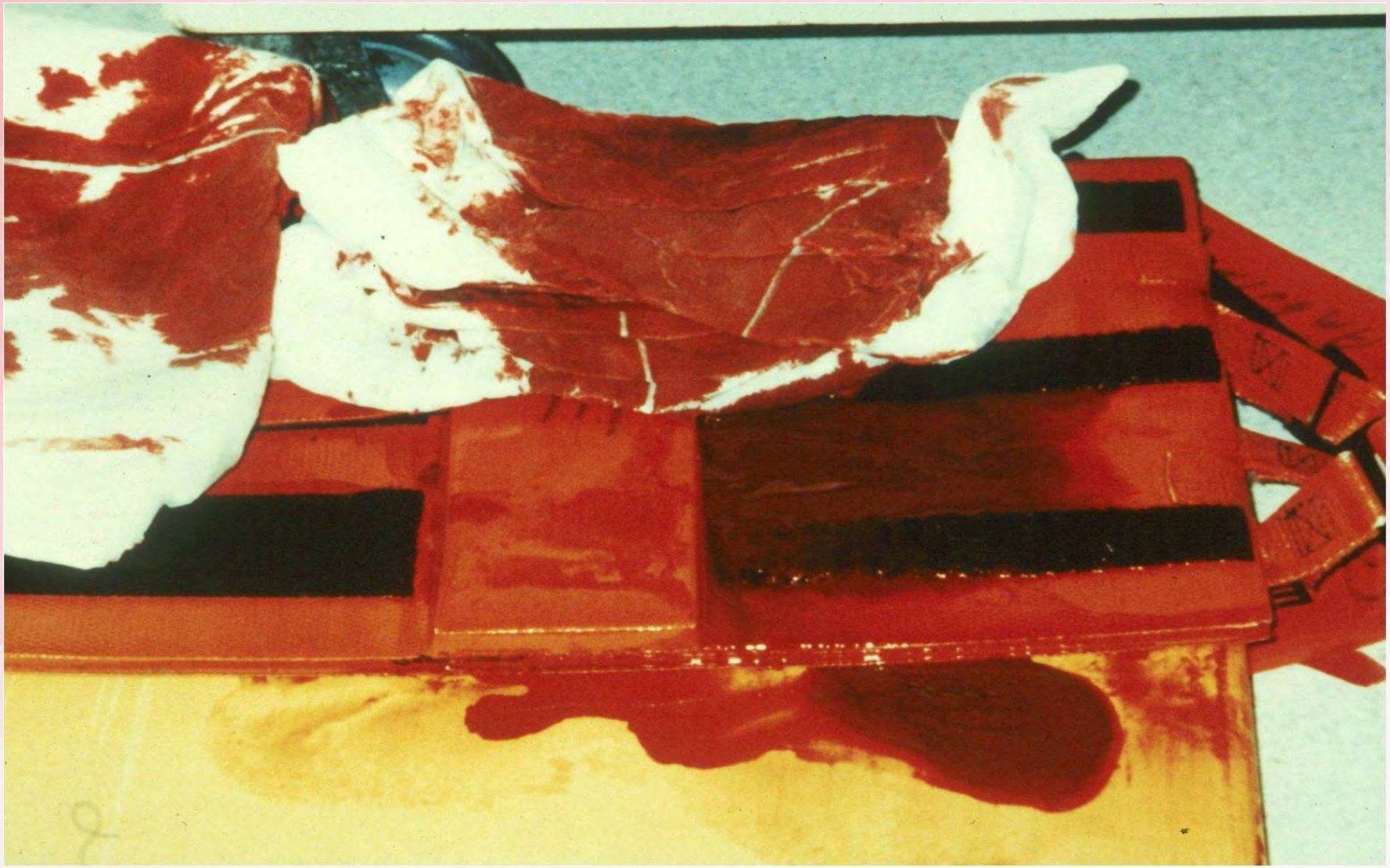
Head Injured Patients on Anticoagulants



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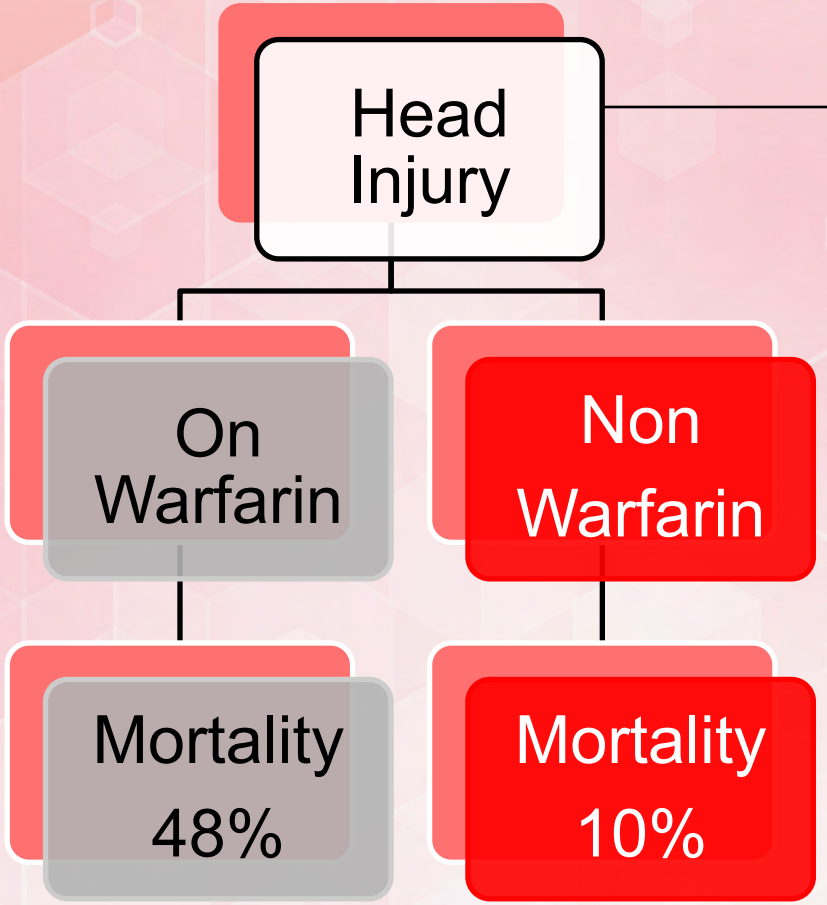
Pre Rapid-Reversal Era



Of these 71% will have Minor Intracerebral Hemorrhage

↓

Will Present With

↓

GCS ≥ 14

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Principles of Warfarin Rapid Reversal in Head Injured Patients

1st principle: recognition of the high risk patient

Any patient with **known or *suspected*** TBI while on warfarin is considered AT RISK regardless of GCS

If GCS ≤ 13 → Trauma Activation

If GCS ≥ 14 → Stat ED consult

This provides higher priority to immediate INR and CT Scan

2nd principle: is rapid reversal of elevated INR

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

Reversal Products

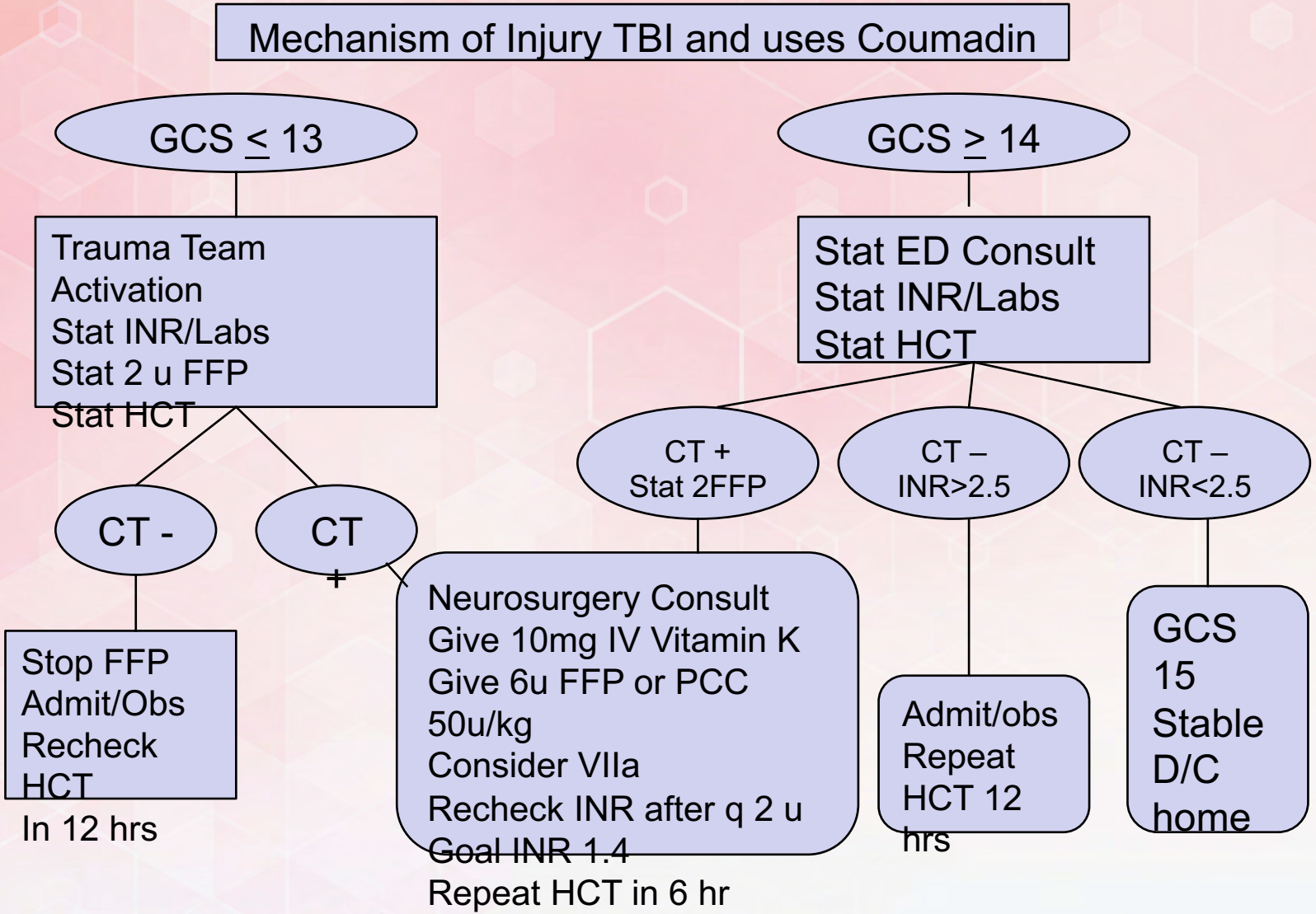
Prothrombin Complex Concentrate (PCC)

- 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

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

Sample Warfarin Reversal Guideline for TBI



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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

Dabigatran (Pradaxa)

- Oral direct thrombin inhibitor
- Half life is 12-17 hours
- No reversal agent!

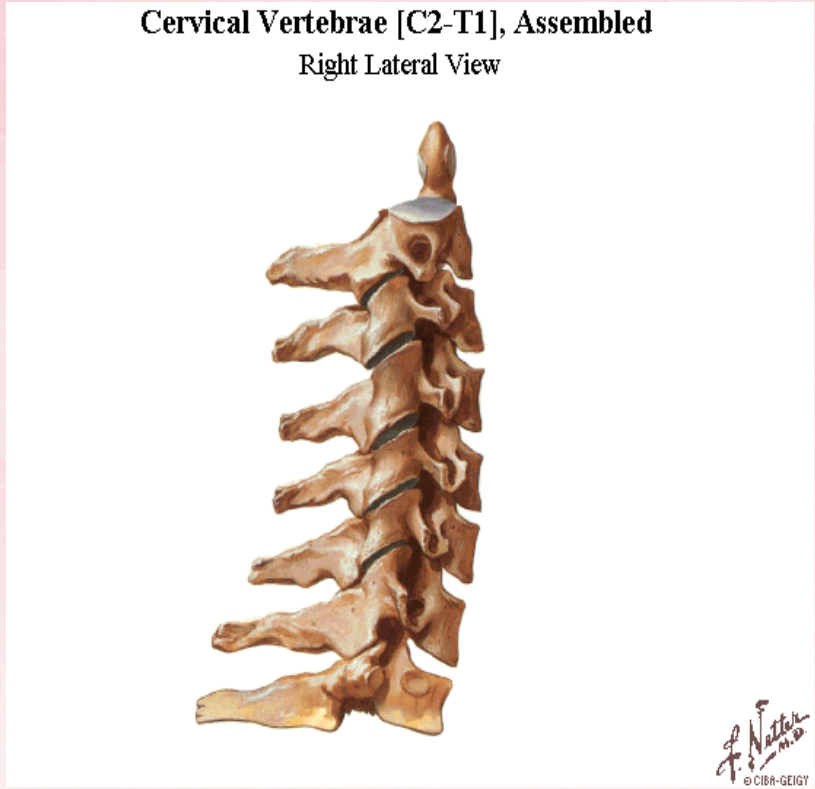
  FFP, PPC, Platelets don't work
- Dialysis will remove 60% of drug in 2-3 hours

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.



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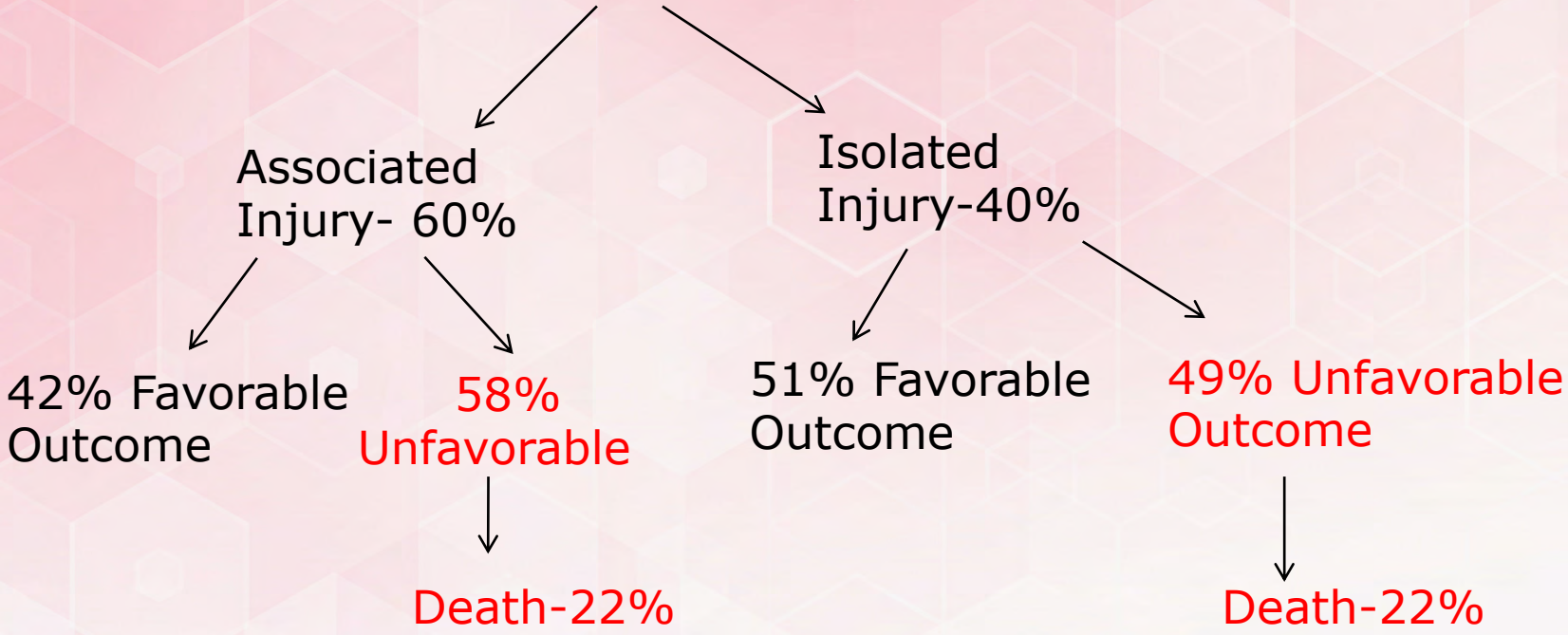
Low Impact Isolated Cervical Spine Injuries (LISCI) in Elderly

138 elderly patients with LICSI and no Spinal Cord Injury



(Golob, 2008)

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Flexion Injuries

Teardrop Fracture

Compression Fracture

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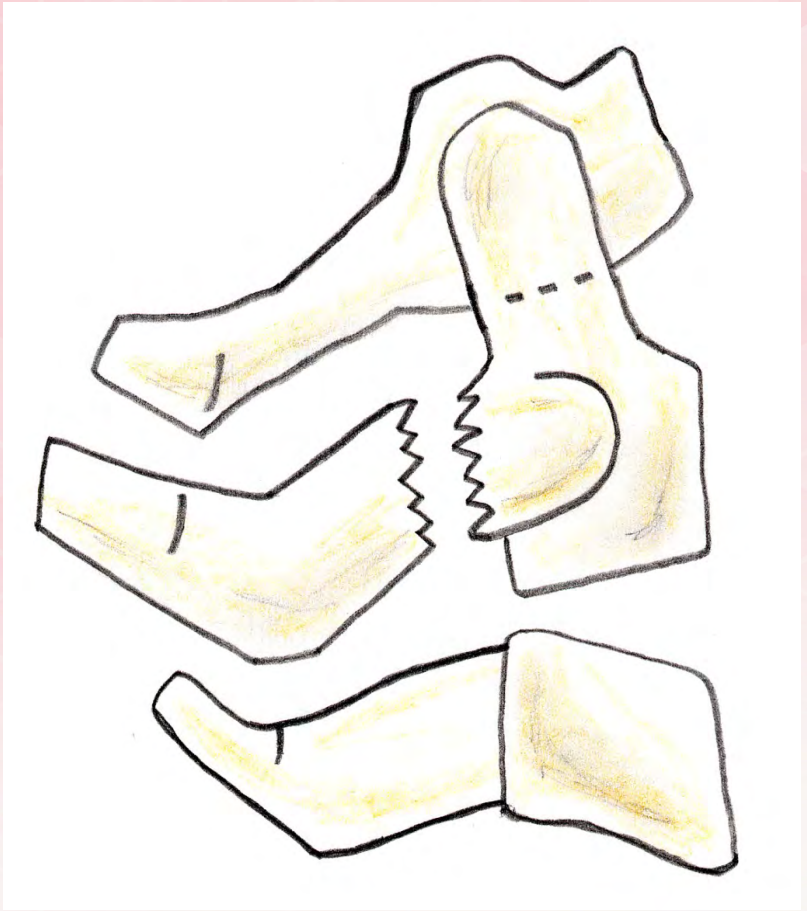
Flexion Injuries

Anterior Subluxation

Extension Injuries

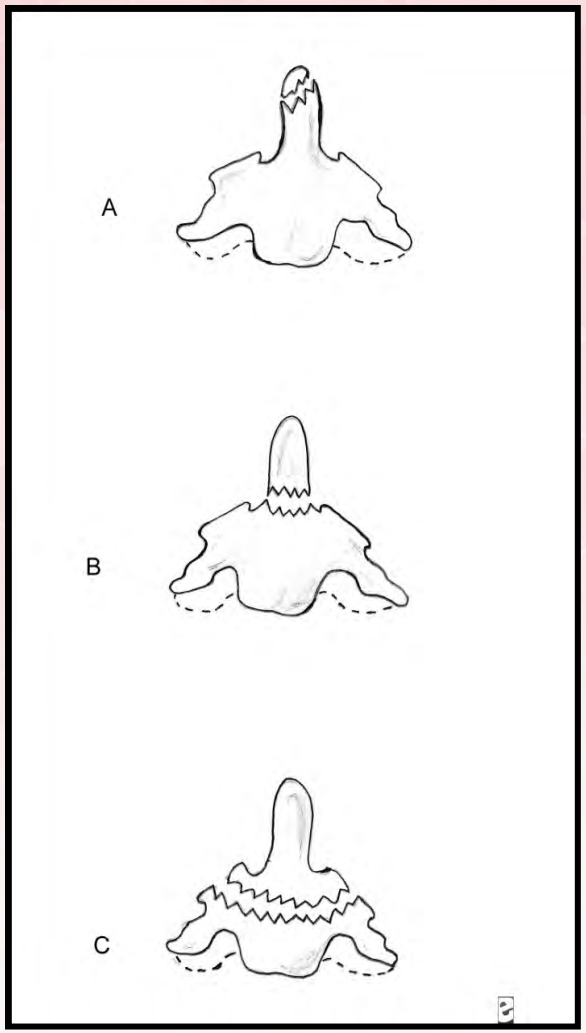
Hangman Fracture

- 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.



Odontoid Fractures

- Most common cervical spine fracture in the elderly.
- Comorbidities and ubiquitous presence of degenerative changes in the C-spine predispose the elderly to complications and poorer outcomes.



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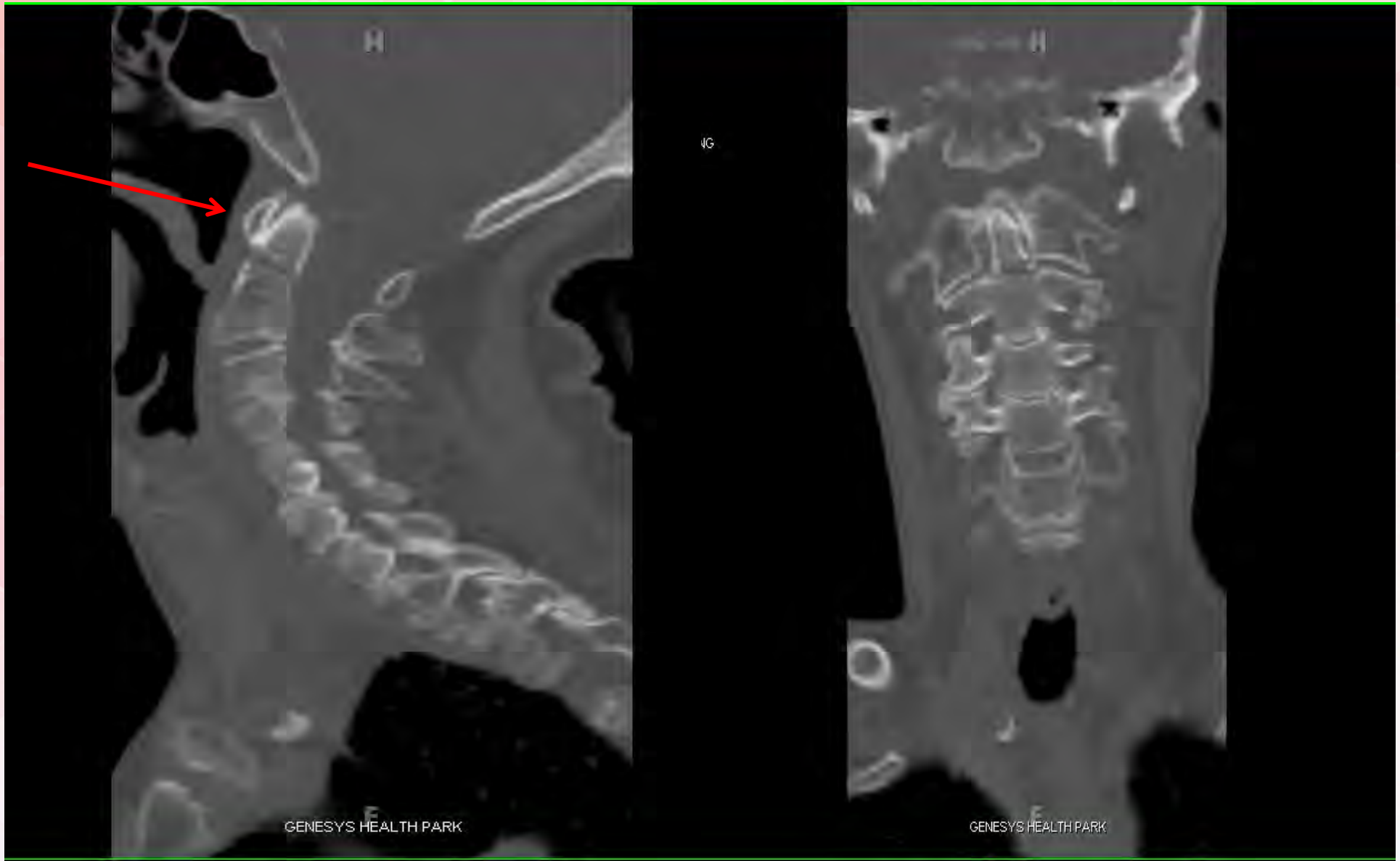
89 Year Old Female With Odontoid Fracture




diologist
L
PORTABLE
GENESYS HOSPITAL 4TH FLOOR

Cervical Orthosis (orthopedic appliances)

Is fracture stable?

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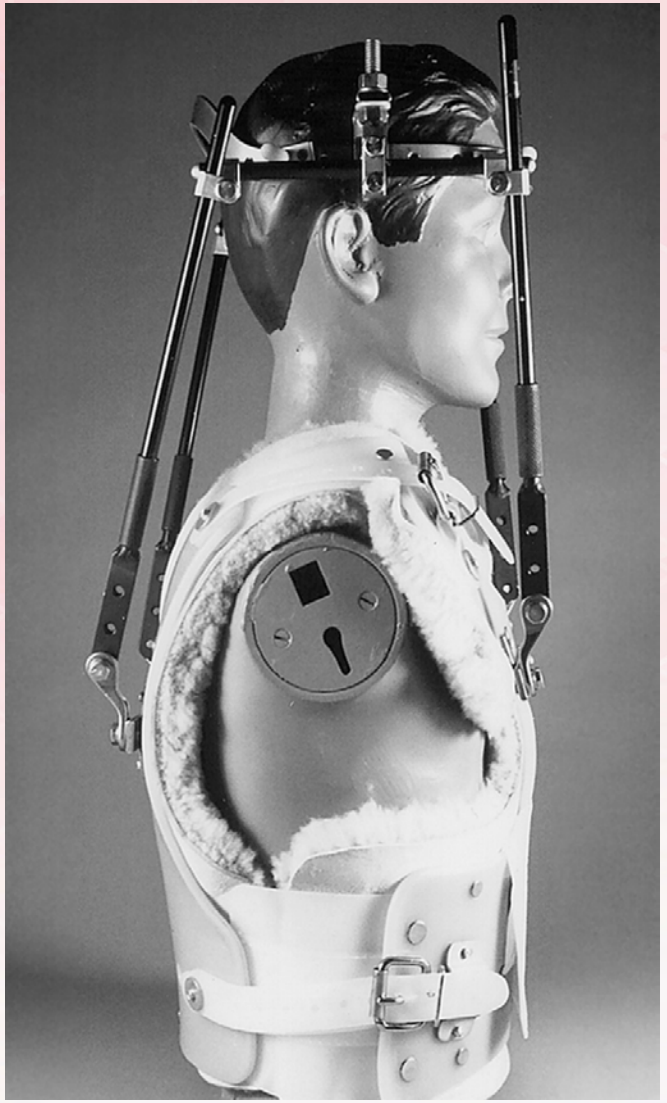
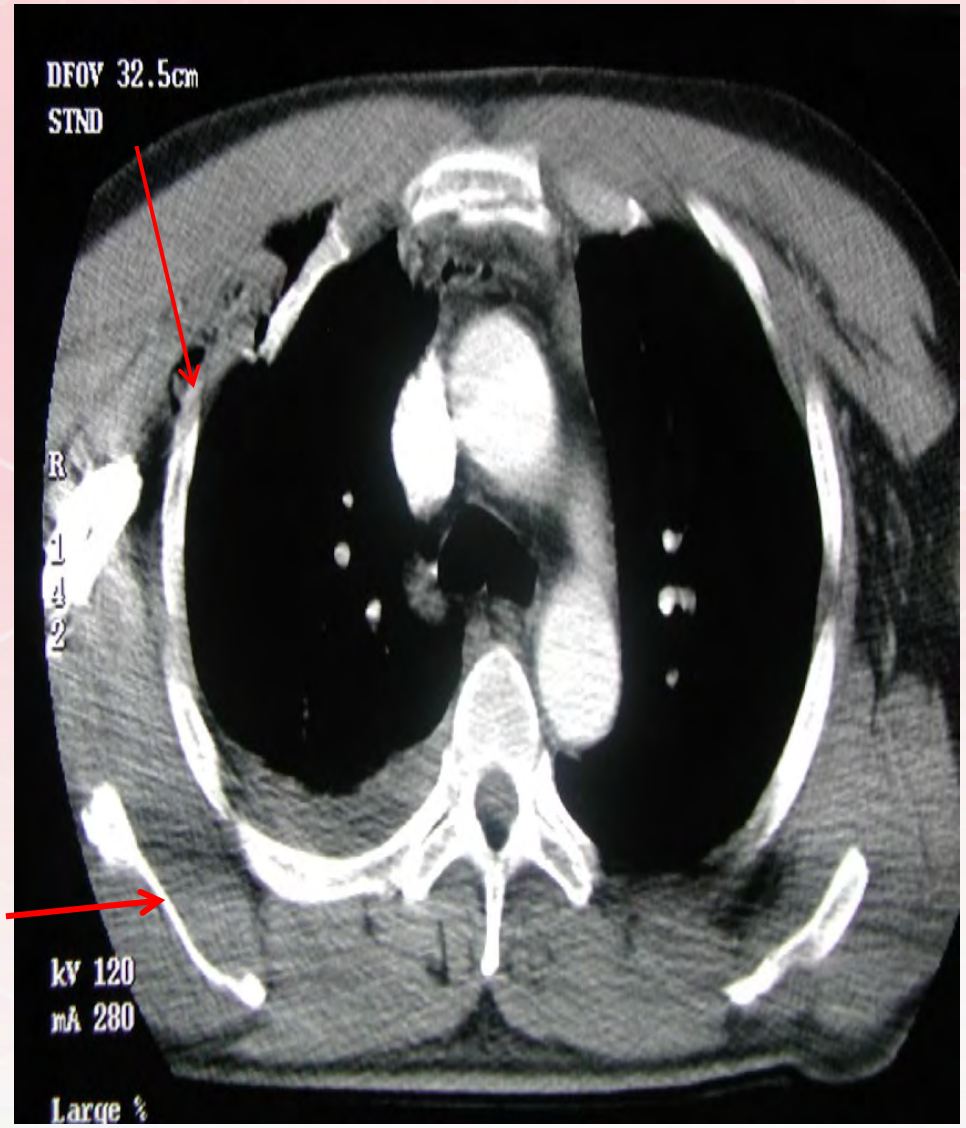
Halo Vest

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



Rib Fractures

- Most common injury in elderly blunt chest trauma
- Each additional rib fracture increases the odds:
  - Pneumonia by ~30%
  - Dying by ~20%
- Increased ventilator days
- Increased ICU days



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

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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

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Pain Management

Opioids

- Multiple Side Effects:
  - Respiratory Depression
  - Delirium
  - Constipation
- Avoid use of:
  - Methadone
  - Propoxyphene
  - Meperidine
  - Due to toxicity of metabolites

Non Steroidal Anti-Inflammatory Drugs (NSAIDs):

- Ibuprofen 800mg IV q6 hrs or
- Toradol 15mg IV q6 hrs
- Limit IV-NSAID therapy to < 5 days

Contraindications to NSAID's:

- Allergy to aspirin or any NSAID
- Asthma, Urticaria, Allergic reaction
- On anticoagulants
- Peptic ulcer disease

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Pain Management

EAST Guidelines 2016

New guidelines recommend:

- Epidural analgesia in combination with other methods of analgesia vs. use of opioids alone
- Preferred for severe blunt thoracic trauma
- New guidelines place strong emphasis on patient preferences and values
- Some studies show limited usefulness of epidural anesthesia in trauma

(Galvagno, et al, 2016; Carrier, 2009)

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.

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

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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

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

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

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

Vital Signs

- BP 118/60
- P120 irregular
- R 28 with audible wheezing
- T 36 c (96.8f)
- Pulse ox 92% on 100% O2

Neuro Status

- PERLA, oriented only to person, speech slurred, obeys inconsistently

- GCS 13-14

Additional Info

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

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

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

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 deletarious affects on their outcome.
- They will be us……

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TRAUMA LECTURES

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Burn and Inhalation Injury

Objectives

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

- Identify types of burn injury
- Describe assessment of the burn patient
- Identify patients requiring transfer to a burn center

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Epidemiology

- About 450,000 burns per year receive medical treatment
  - 67% male
  - Mostly age 20 to 29
  - 9% are <16 years
  - 14% are Elderly >60 years
- 40-50,000 patients require hospitalization
- More than 75% of the reported burn cases were less than 10% total body surface area burns (TBSA)

(Centers for Disease Control and Prevention, 2014)

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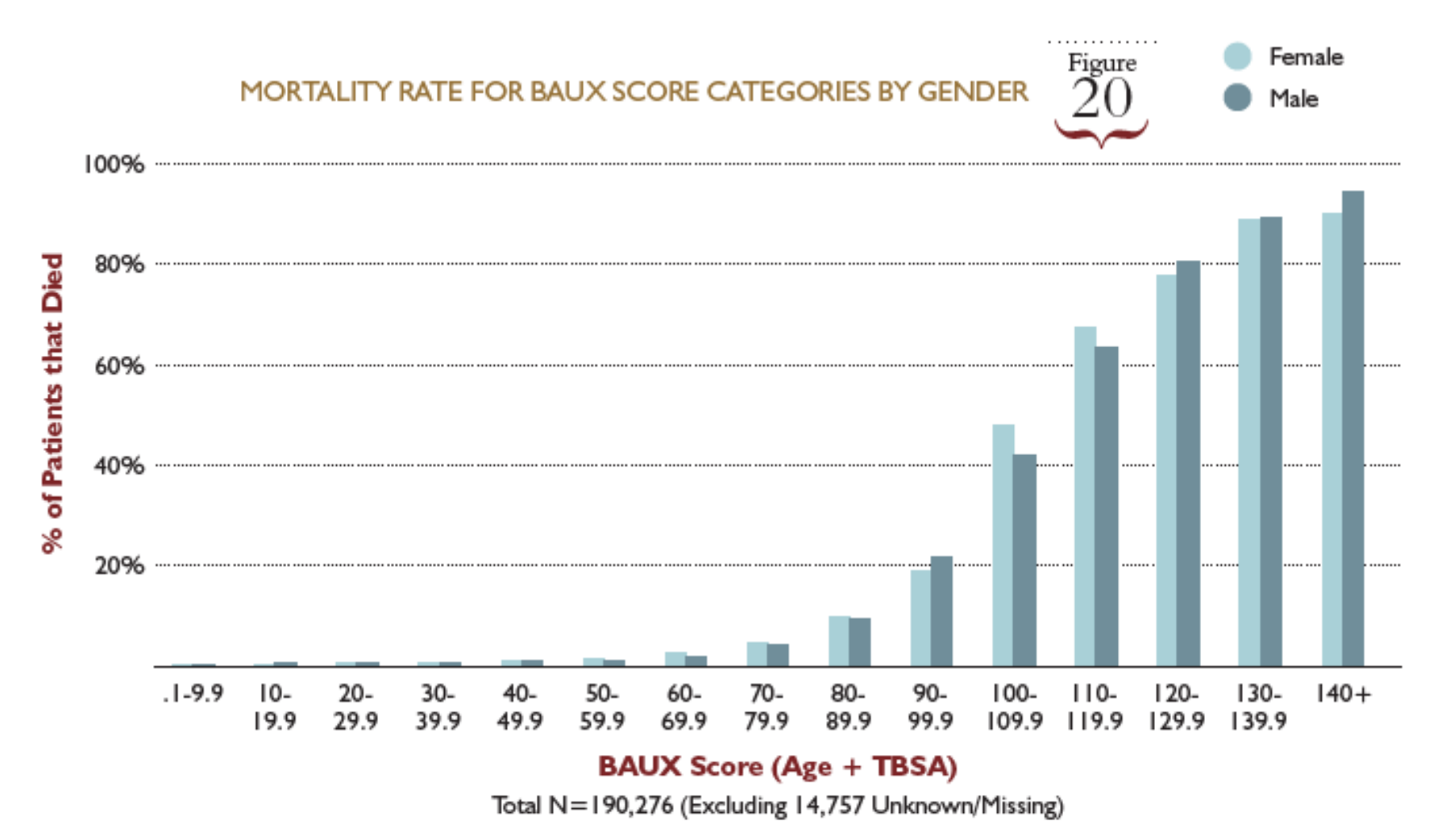
Morbidity and Mortality

- ~4% mortality rate for all type of burns
- Factors affecting mortality:
  - Age
  - %TBSA
  - inhalation injury
- Most post burn morbidity & mortality due to infection
- Advanced age and high %TBSA associated with very high morbidity

Morbidity and Mortality



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Resources

- For survivors, average LOS was slightly greater than 1 day per %TBSA
- For non-survivors, LOS is twice as long
- For burns > 10%TBSA, average cost is $250,000-350,000
  - Higher among non-survivors

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Mechanism of Burn

- Flame 41.4%
- Scald 33.3%
- Contact 8.7%
- Chemical 3.4%
- Electric 3.2%

Extent of Burn: Rule of 9's

- % TBSA calculation
  - Rule of 9's
  - Peds vs. adults
  - Palm is equal to 1%

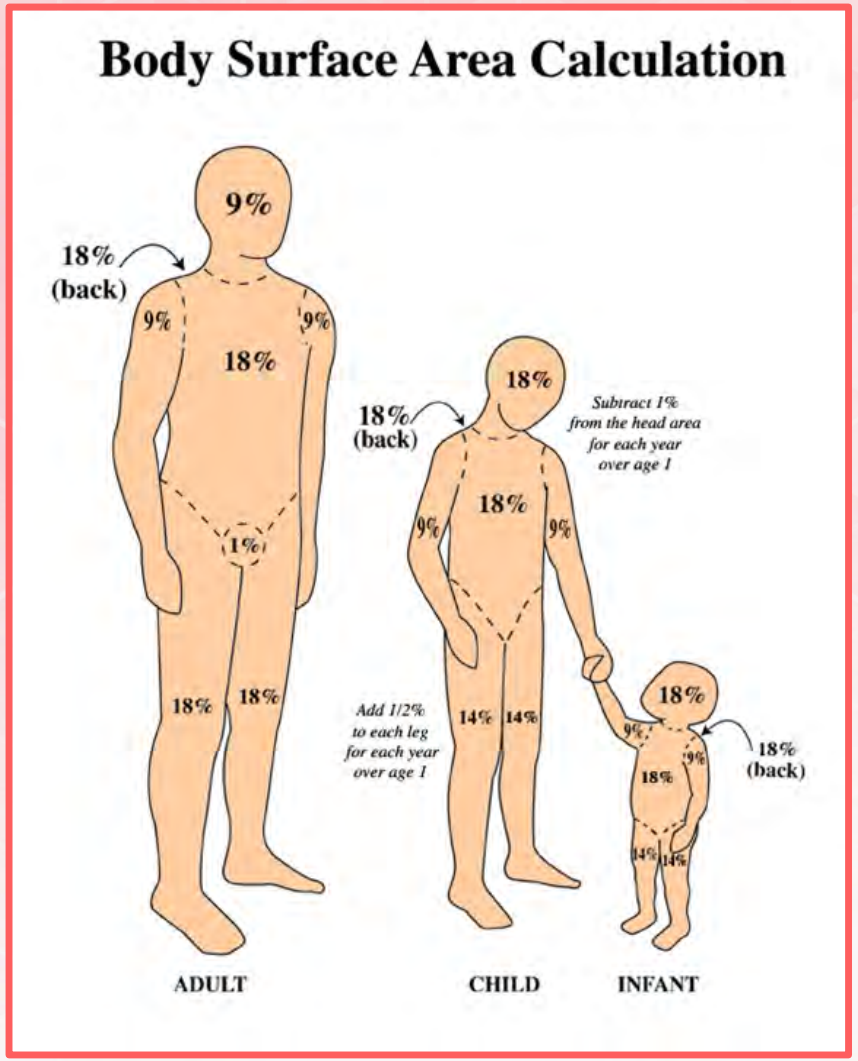

Illustration courtesy University of Michigan Trauma Burn Center © (Greenhalgh, 2016)

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Severity of Injury

- **Depth**
  - Superficial
  - Superficial partial thickness
  - Deep partial thickness
  - Full thickness
- **Extent of burn**
  - Rule of 9's, palm equals 1%
- **Age**
  - <2 and >60 at increased risk
- **Past Medical History**
- **Location of burn**
- **Concurrent trauma**
- **Smoke inhalation**

(Greenhalgh, 2016)

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Anatomy of the Skin

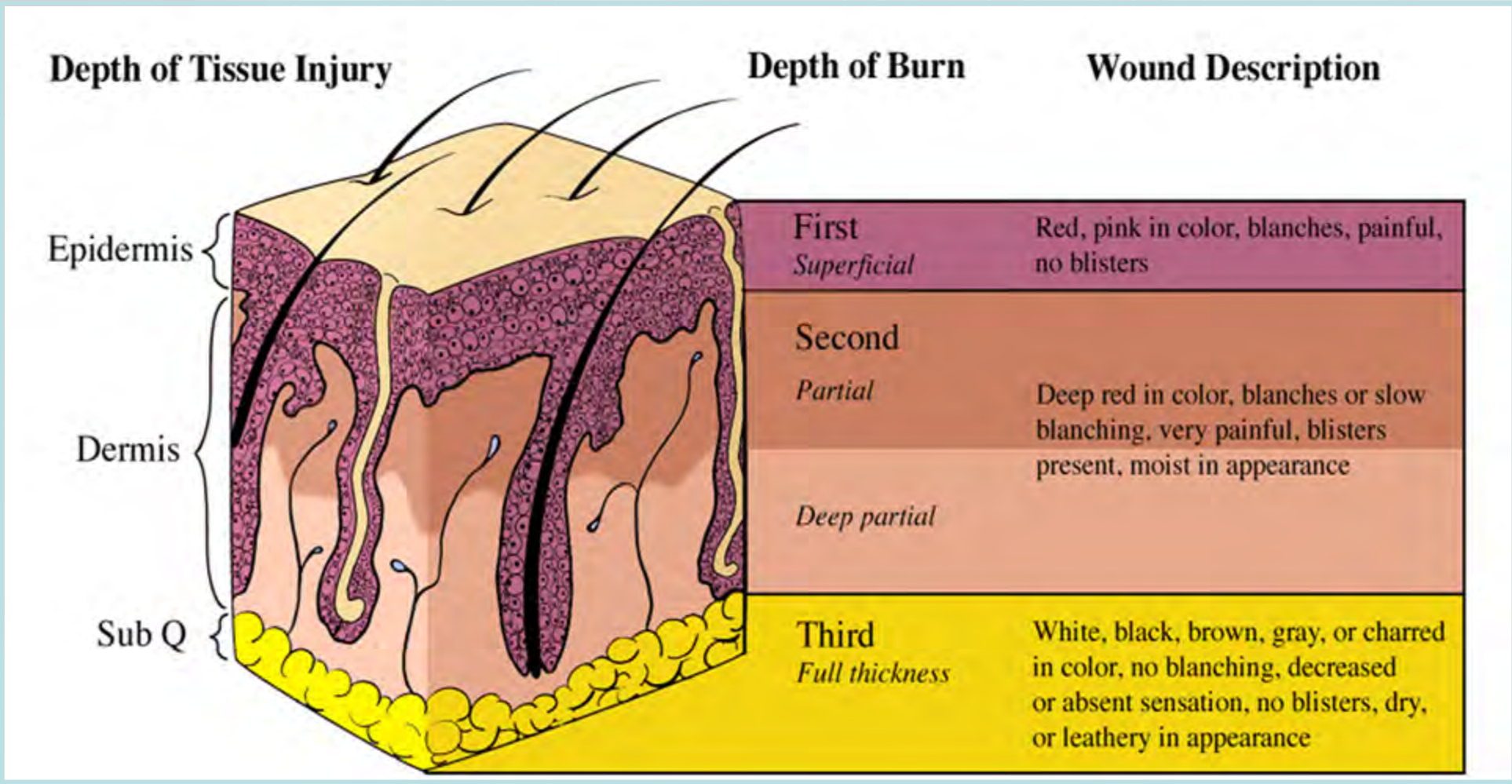

Illustration courtesy University of Michigan Trauma Burn Center ©

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Functions of the Skin

- Prevention of infection
- Conserve body fluids
- Temperature regulation
- Cosmetic appearance
- Sensation and touch

(Greenhalgh, 2016)

Burn Pathophysiology

- Inflammatory mediators
  - Shock
  - Hypovolemia
  - Increased pulmonary and vascular resistance
  - Myocardial depression

(Greenhalgh, 2016)

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Depth: Superficial Burns

- First degree
- Pink in color
- Damage to epidermis
- Do not count in TBSA calculation
- *No resuscitation fluid necessary*
- Heals on its own

(Greenhalgh, 2016)

Depth: Partial Thickness Burns

- Second degree
- Damage to epidermis & part of the dermis
- Differentiated as superficial or deep partial thickness:
  - Superficial: Pink to red, wet appearance, painful, will heal on its own
  - Deep: Mottled red/white with slow blanching. May convert to full thickness. May require operative intervention

(Greenhalgh, 2016)

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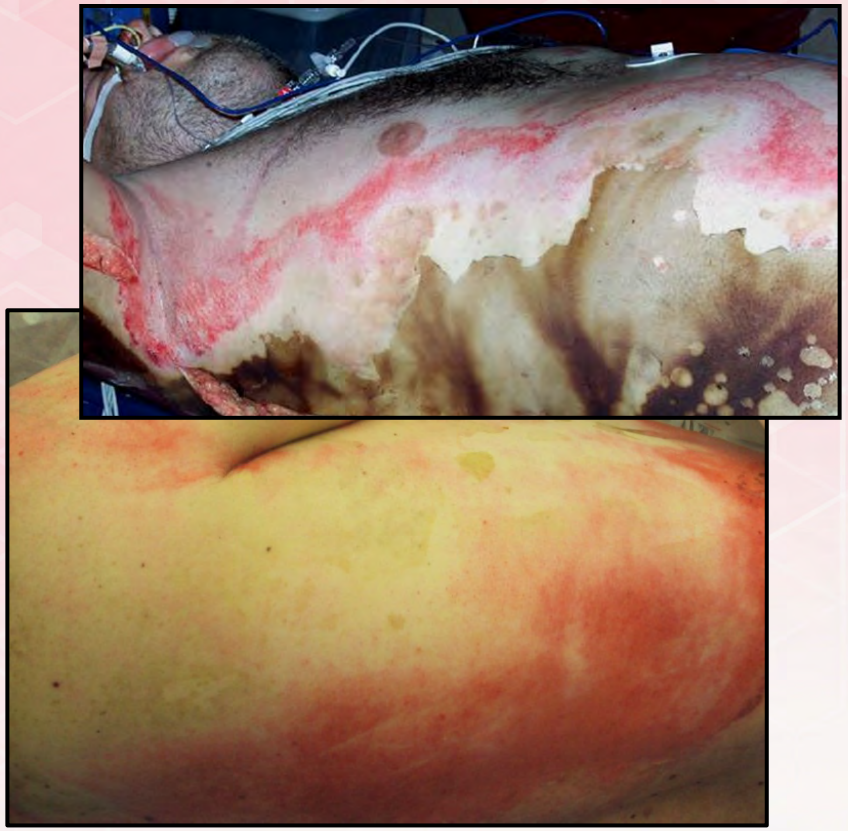
Depth: Full Thickness Burns

- Third degree
- White, black, brown in color, dry, leathery in appearance.
- Burned skin non-pliable
- Circumferential third degree may require escharotomy.
- Skin grafting required.



(Greenhalgh, 2016)

Inhalation Injury

- 7-10% of admission to burns centers have concomitant inhalation injuries
- Incidence increases with TBSA
- Associated with high mortality
  - Identified in 60-70% of patients who die in burn centers
- Diagnosed and graded 0 to 4 based on severity via bronchoscopy.

Inhalation Injury

- Assessment
  - History
  - Singed hair
  - Carbonaceous sputum
  - Hypoxia, SOB
  - Stridor, hoarseness
  - Oropharyngeal erythema
- Treat with 100% Oxygen and early intubation

(Heffernan & Comeau, 2015)

Initial Management

- Stop the burning
- Airway and breathing
- Circulation
  - Extent of burn
  - Depth of burn
  - Begin resuscitation
  - Limb threat injuries
- Transfer to burn center

(Heffernan & Comeau, 2015)

ABA Burn Center Referral Criteria

- Partial thickness burns >10%
- Burns to face, hands, feet, genitalia, perineum, or major joints
- Full thickness burns any age
- Electrical burns
- Chemical burns
- Inhalation injury
- Patients with pre-existing medical conditions
- Patients with burns & concomitant trauma
- Pediatric burns
- Patients who will require special social, emotional, or long-term rehab intervention

(Heffernan & Comeau, 2015; American Burn Association, 2006)

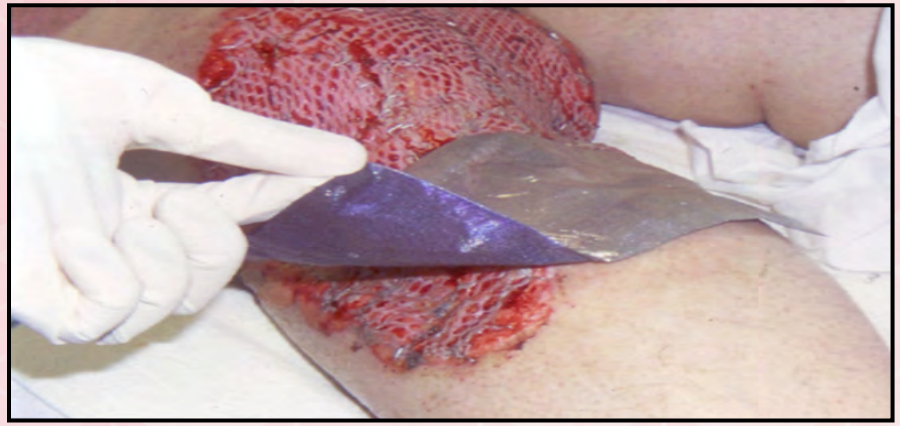
Preparation for Transfer

- Monitor urine output and adequacy of resuscitation
- Keep patient warm and dry
- Secure all lines and tubes
- Wound care
- Manage pain

(Heffernan & Comeau, 2015)

US Burn Centers

- Only 60% of US burns admitted to burn centers
  - Burn Center's average 200 admits per year
  - Non burn acute care hospitals average <3 per year
- Specialized nursing and medical team including OT, PT, Social Work and more…



(American Burn Association, 2016)

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Initial Fluid Resuscitation

- Burns >20-25% TBSA
- LR infusion
  - ≤ 5 y/o – LR – 125 ml per hour
  - 6-13 y/o – LR - 250 ml per hour
  - ≥ 14 y/o - LR – 500 ml per hour
- Monitor urine output
  - Adults 30ml/hour
  - Pediatric<40kg:1 ml/kg/hour
- Complications:
  - Shock
  - Acute renal failure

(Pham, Cancio, & Gibran 2008)

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Burn Resuscitation Formula

- Adult & Chemical Burns:
  - **2 ml LR X kg X %TBSA**
- Pediatric (14 years or under and less than 40kgs):
  - **3 ml LR X kg X %TBSA**
- Adult High Voltage Electric Injuries:
  - **4 ml LR X kg X %TBSA**
- Pediatric High Voltage Electric Injuries
  - Consult Burn Center
- %TBSA: calculated based on full & partial thickness burns, NOT superficial burns

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Example Resuscitation Formula

- 50 % TBSA (Full and partial thickness degree burns only)
- Age: 28
- Mechanism: explosion
- Weight: 70 kg
- 2 ml X 70kg X 50 % TBSA = 7,000 cc
- Give 3,500 ml over the first 8 hours
- Give the other 3,500 ml over the next 16 hours

Escharotomy

- Circumferential Injury
- Full Thickness Burns
- Limb Threatening

Escharotomy

- Indicated in full thickness burns that surround an extremity (circumferential).
- When circumferential, burn eschar can cut off blood supply to the extremity, leading to loss of limb.
- Assessment requires frequent pulse exam.
- If pulses are absent, then escharotomy and referral to a burn center is indicated.
- Chest wall may require escharotomy
  - Look for peak pressures on ventilator & decreasing tidal volumes

Special Considerations

Trauma Combined with Burn Injury

- Assess ABC's
- Administer fluid resuscitation
- Don't be distracted by burn
- Treat life threatening injuries first

(Santaniello et al. 2004)

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Special Considerations: Pediatric Burns

- Psychosocial issues
  - Abuse, neglect
  - Pattern of injury
- Airway
  - Airway size and shape
- Breathing
  - Chest wall more compliant
- Circulation
  - Children < 10kg should have D5LR for resuscitation

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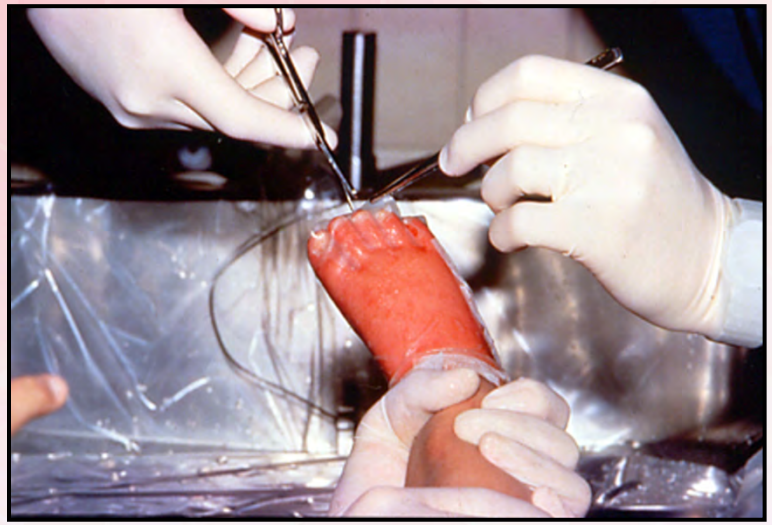
Special Considerations: Pediatric Burns



Circulation

- Larger surface area
- Increased volume needs
- Hypothermia risk
- Thinner skin depth

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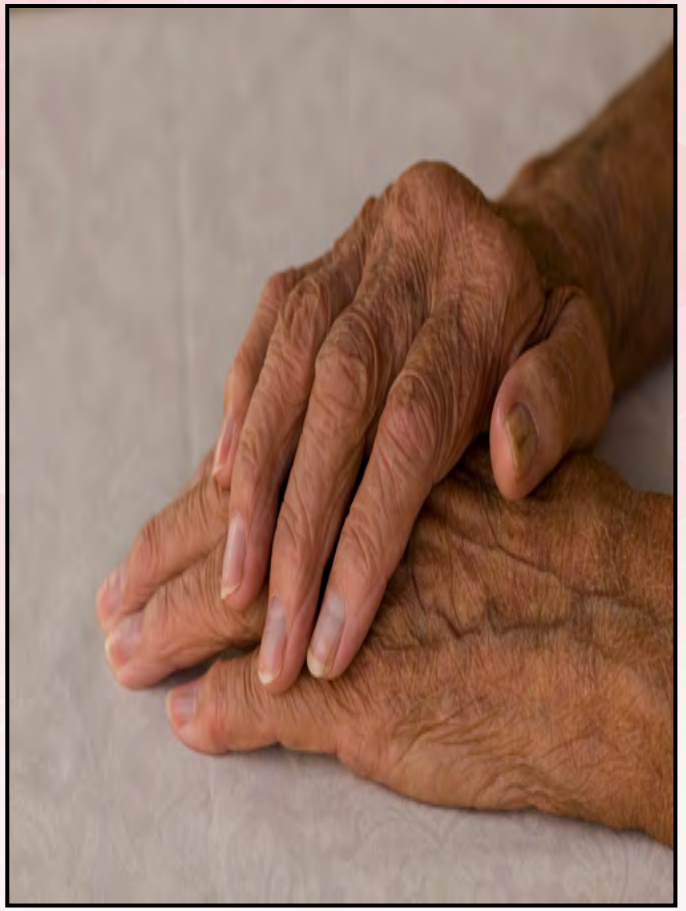
Special Considerations: Geriatric Burns

- Contact with flame is most common (50%), followed by scald (20%)
- Pre-injury health status- pre-existing conditions
- Abuse or neglect
- Skin is thin, burn can be deep
- Decreased reserves to stress response
- May need additional monitoring to guide resuscitation.



(Herndon, 2012)

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Chemical Injury

Alkali > 7.0

Acid <7.0

Organic

- **Treatment**
  - Remove clothing
  - Brush off powder
  - Copious irrigation
  - Splash injury common
  - Check eyes

Chemical Burn Pattern

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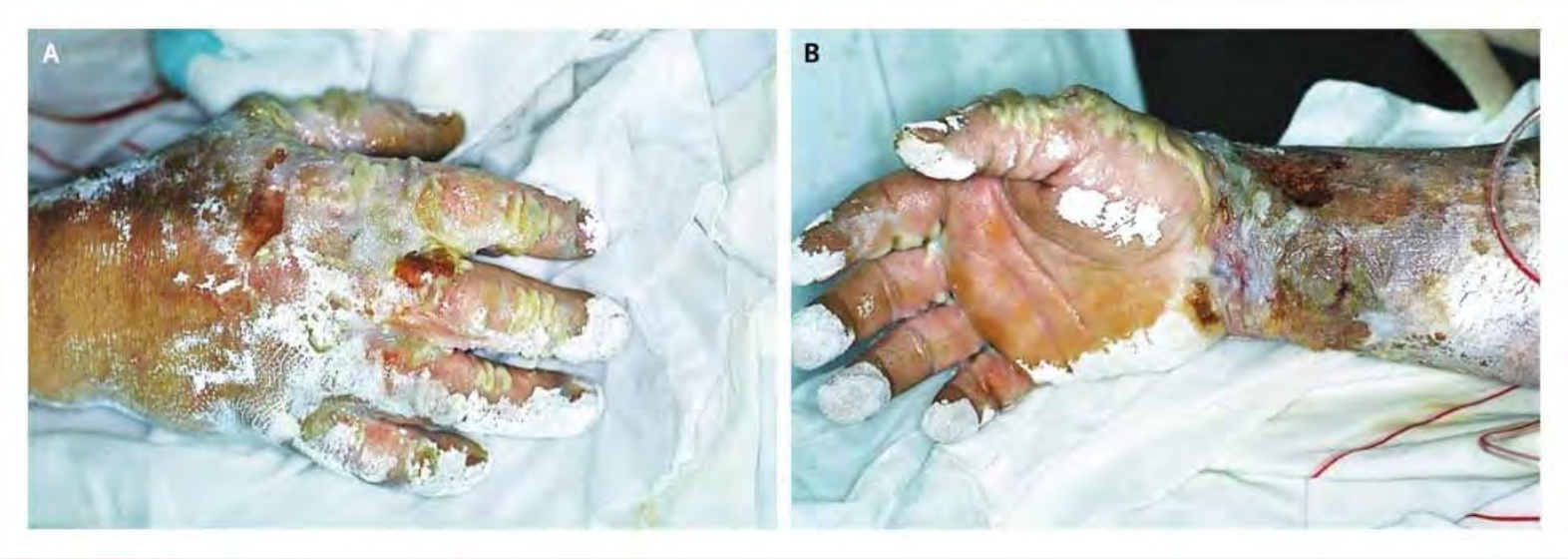
Hydrofluoric Acid Burn

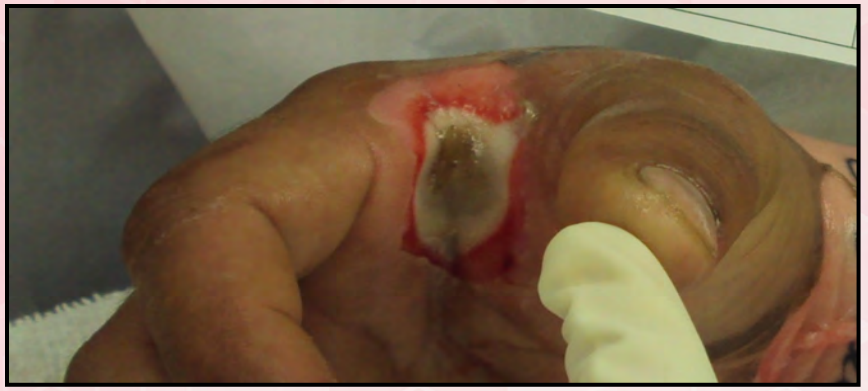
- Treated differently than other types of chemical burns
- Requires additional neutralization of fluoride ions
- Fluoride ions → toxic, tissue necrosis
- Fluoride binds to calcium leading to hypocalcemia and dysrhythmias
- Consult burn center for neutralization

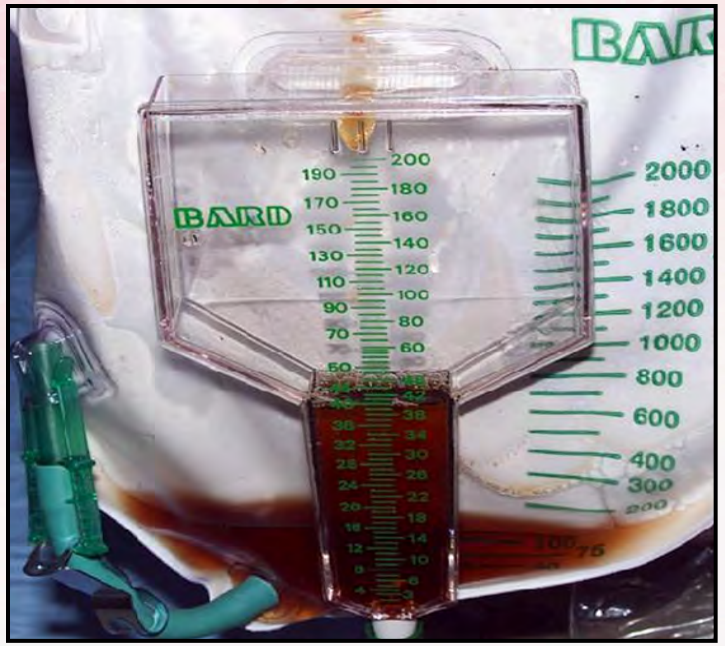


(Greenhalgh,2016; Herndon, 2012; Dunser & Riderder, 2007)

Electrical Injury

- Concerning when source is > 15,000 volts
- Often work related
- Extent difficult to determine, damage often lies in deep tissues
- Cardiac monitoring
- Observe for:
  - Hemoglobinuria; port wine color urine
  - compartment syndrome
- Fluid resuscitation with goal of 75-100 cc/urine/hour





Cold Injuries

- Hypothermia
- Frostbite

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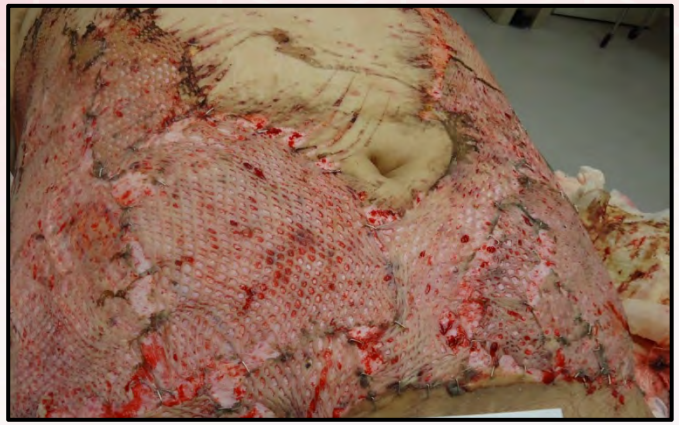
Frostbite

- Causes extracellular and intracellular ice to form
  - Leads to cellular dehydration and rupture
- After thawing, microvascular thrombosis occurs,
  - Leads the wounds to develop necrosis or eschar
- To prevent further damage, it is important to re-warm the patient and prevent re-freezing.
- It often takes several weeks to months to determine full extent of injury.
  - Often results in loss of digits

Skin Grafting

- Split Thickness Skin Graft (STSG)
  - Full thickness burns
  - Meshed vs Sheet
- Donor site: partial thickness, into dermis, heals in 2 weeks



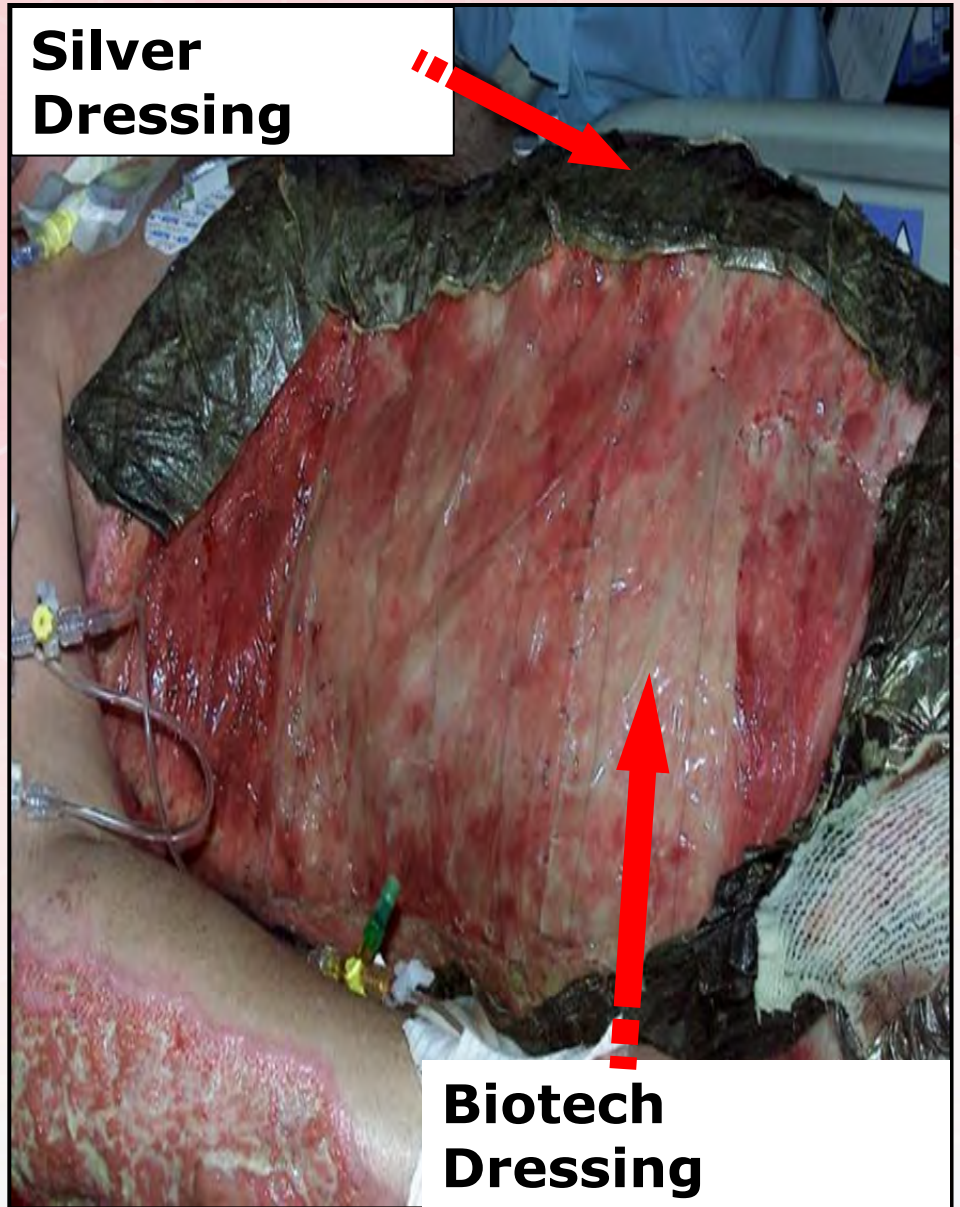
Meshed Versus Sheet Autograft

Donor Sites

- Painful
- Heal on their own
- STSG donor sites maybe re-harvested

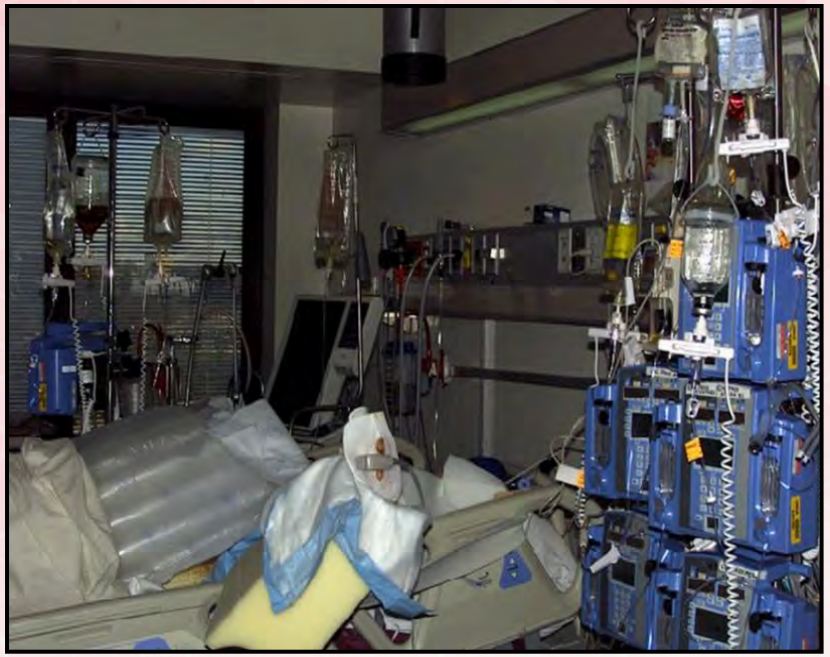
Wound Care

- Cleanse wound with saline or soap and water.
- Major advancement in burns
- Topical antimicrobial creams
- Biotechnology dressings
- Silver dressings



Complications

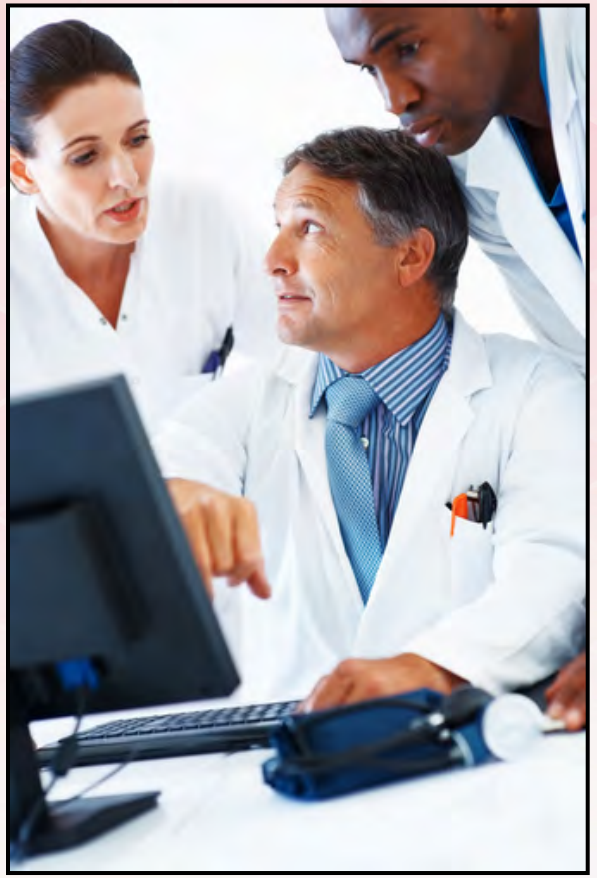
- Inadequate resuscitation
  - Renal Failure
- Over resuscitation
  - Abdominal compartment syndrome
  - Pulmonary edema
  - Peripheral edema
- Debate continues regarding resuscitation endpoints



(Herndon, 2012; Cancio, Salinas, & Kramer, 2016; Jeng, Lee, Jablonski, & Jordan, 1997)

Burn Research Challenges

- Evidence based practice
  - Small volume of large burns to study
  - Burn centers geographically isolated
  - Lack of standards for training
  - Perpetuates apprenticeship mindset
  - Few rigorous multi-center trials
  - Inconsistent techniques/philosophies among burn centers
- Burn State of the Science
  - Develop national research agenda



(Wood, 2013; Palmieri & Klein, 2007)

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Future Considerations

- Biotechnology
- Dermal replacement
- Stem cells
- Resuscitation endpoints
- Methods to stop capillary leak

Summary

- Initial burn management priorities include
  - Maintain adequate airway
  - Adequate fluid resuscitation
    - Calculate TBSA and use the Burn Consensus Formula
  - Transfer patient to a burn center if necessary
- Special considerations when caring for pediatric or elderly
- A national burn research agenda is needed to develop standards of care & evidence based practice

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Obesity and Trauma

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Objectives

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

- Describe how the obesity epidemic impacts the delivery of trauma care.
- Describe how obesity impacts body systems.
- Discuss the challenges and considerations associated with resuscitation.
- Describe management approaches to care of the injured obese patient with blunt, penetrating, or burn injuries.

Introduction

- Healthcare is focused on improving performance and raising quality.
- By 2020 it is expected that a majority of Americans will be overweight.
- Trauma is the leading cause of morbidity and mortality.

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Background Definition

BMI = weight (kg)/height $(m)^2$

Calculation	Category
<18.5	Underweight
18.5-24.9	Normal weight
25-29.9	Overweight
30-39.9	Obese
>40	Morbidly obese

(World Health Organization, 2017)

Background Definition

BMI = weight (kg)/height $(m)^2$

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30-39.9	Obese
>40	Morbidly obese

(World Health Organization, 2017)

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Current State of Obesity

Ranking of Obese Countries
1. United States
2. Mexico
3. United Kingdom
4. Slovakia
5. Greece
6. Australia
7. New Zealand
8. Hungary
9. Luxenbourg
10. Czeck Republic

- Currently impacts 1/3 of population
- By 2020, 3:4 Americans
- US ranks first in the world
- BMI proportionate to risk of injury
- Workplace injuries

(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

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Current State of Trauma

- Leading Causes
  - MVC (ages 1-44 yo)
  - Falls (0-14yo and >65yo)
  - Firearms
    - Suicide (ages>14yrs)
    - Homicide (ages 1-64 yrs)
  - Burns (1,200/year)

- Workplace injuries
  - Fractures
  - Dislocations
  - Sprains
  - Strains
  - Concussion

Obesity alone from blunt trauma increases mortality 6-fold.

(World Health Organization, 2017)

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Consequences

- $478.3 billion
- $1,500+ per person higher than normal weight
- Training/Equipment
- Management guidelines
- Outcomes
- Long-term care
- Loss of productivity
- Third-party payors
- Workman's Compensation

Outcomes
Increased hospital length of stay
Increased number of ventilator days
Increased mortality rate
Increased complications
Newly diagnosed comorbidities

(Greenberger & Werman, 2014; Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013).

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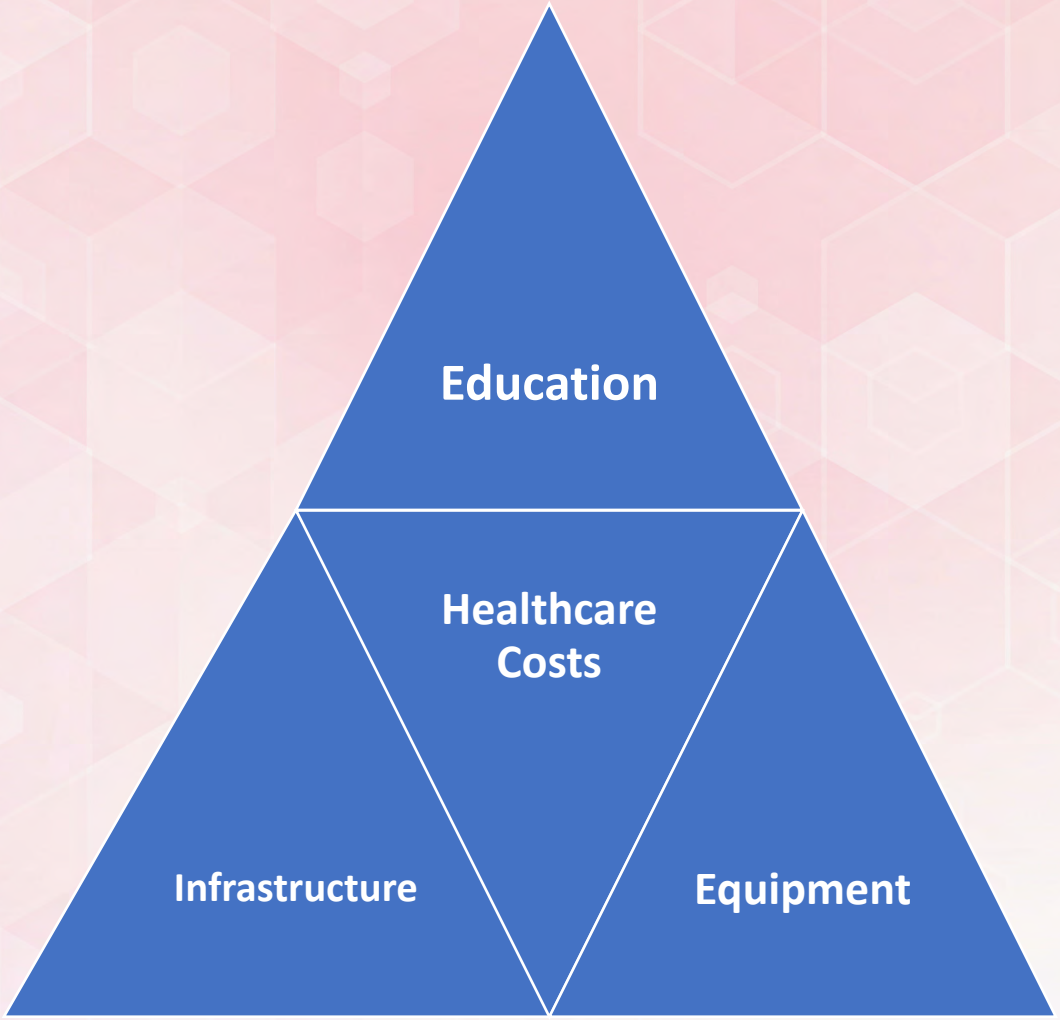
Triad



(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

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Injury Patterns

- Blunt
  - Motor vehicle collision (MVC)
    - Lower ISS
    - Decreased seatbelt use
  - Falls (earlier in life)
    - Knee dislocations
    - Nerve and vascular injury
  - Workplace

Kinetic energy = $1/2mv^2$

- Penetrating
  - Missed injuries
- Burn
  - Rule of Five
    - Torso 50%
    - Lower extremities (20% each)
    - Upper extremities (5% each)
    - Head (2%)

(Osborn, Rowitz, Moore, Oliphant, Butler, Olsen, & Aucar, 2014)

Injury Patterns

When compared to normal weight patients:

- Fewer head injuries (but more fatal)
- Fewer liver lacerations (“Cushion Effect”)
- Severe extremity fractures
- Increased rib fracture
- Increased pulmonary contusions

(Osborn, Rowitz, Moore, Oliphant, Butler, Olsen, & Aucar, 2014)

Injury Patterns

Male

- Head
- Face
- Spine
- Thorax

Female

- Thorax
- Abdominal
- Extremity

Center of gravity

(Greenberger & Werman, 2014)

Special Populations

- Pediatric
  - Obesity rate rising
  - More extremity injuries
  - Fewer head, abdominal, thorax, and spine injuries
  - Poor outcomes:
    - Higher death rate
    - Higher DVT/PE/Pneumonia complications
    - Longer hospital length of stay
    - More ventilator days

(Witt, Arbabi, Nathens, Vavilala, & Rivara, 2017)

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Cardiovascular
Musculoskeletal
Pulmonary
Obesity
Hematology
Renal
Endocrine
Hepatic

Cardiovascular

- Increase risk of atherosclerotic cardiovascular disease
  - Higher risk of stroke and myocardial infarction
- Increased systemic vascular resistance
  - Hypertension
  - Cardiomyopathy
- Increased circulating blood volume
- Increased cardiac output

(Winfield & Bochicchio, 2013)

Pulmonary

- Asthma
- Visceral adipose tissue
  - Narrows airway
  - Increases collapsibility
- Decreased expiratory reserve volume
- Decreased residual volume
- Decreased vital capacity
- Obstructive sleep apnea

Obesity Hypoventilation Syndrome

- $pCO_2 > 45mmHg$
- $pO_2 < 75mmHg$

(Winfield & Bochicchio, 2013)

Renal

- Chronic kidney disease (may require dialysis)
- Decreased renal perfusion
- Decreased autoregulation
- Increased angiotensinogen
  - Efferent arteriolar vasoconstriction
  - Increased glomerular pressure
  - Decreased cellular proliferation

(Winfield & Bochicchio, 2013)

Hepatic

- Hyperlipidemia
- Lipotoxity

- Non-alcoholic fatty liver disease
- Non-alcoholic steatohepatitis

(Winfield & Bochicchio, 2013)

Endocrine

- Higher baseline insulin levels
- Higher glucose levels

- In the presents of visceral adipose tissue leads to increased cortisol level

(Winfield & Bochicchio, 2013)

Hematology

- Increased amount of adipose tissue leads to risk for thrombolytic events
- Hyperactive platelets
- Resistant to anticoagulation stimuli

(Winfield & Bochicchio, 2013)

Musculoskeletal

- Normal increased stress on bones and joints
  - Can be described as severe pain
- Osteoarthritis

(Winfield & Bochicchio, 2013)

Expected Comorbidities

- Hypertension
- Asthma
- Stroke
- Kidney disease
- Sleep apnea

CAUTION

Patient may not be aware

(Winfield & Bochicchio, 2013)

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Common Complications

- Infections
  - Blood stream
  - Urinary
  - Wounds
- Pneumonia
- DVT
- Abdominal compartment syndrome
- Acute respiratory distress syndrome
- Multi-system organ failure

(Greenberger & Werman, 2014)

Assessment Principles

- Primary
- Secondary
- Disposition
- Management

Pre-Hospital

Challenges

- C-collar
- Splinting
- Backboards
- Evacuation
- BP cuffs
- IV length

(Greenberger & Werman, 2014)

Airway (C-Spine Protection)

CHALLENGES

- Short thick necks
- Poor extension
- Loss of landmarks
- Adipose tissue
- Fat deposits in pharyngeal tissue
- Gastro-esophageal reflux
- Backboard weight limits
- Increased airway resistance

(Greenberger & Werman, 2014)

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Airway (C-Spine Protection)

CONSIDERATIONS

- Position with head of bed slightly elevated
- Use of sandbags and tape for immobilization
- Gastric tube insertion
- Dedicated member to maintain c-spine control
- Early surgical cricothyrotomy
- Optical equipment (ie: video laryngoscope)
- History of gastric banding
- Halo fixation contraindicated

(Greenberger & Werman, 2014)

Breathing

CHALLENGES

- Fat deposits in diaphragm and intercostal muscles
- Elevated diaphragm
- Rapid desaturation
- Chest weight
- Skin folds
- Increased work of breathing
- Sleep apnea
- Impaired lung compliance
- Tension pneumothorax
- Anesthesia assistance

(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

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Breathing

CONSIDERATIONS

- CPAP/PEEP
- Reverse Trendelenburg
- Move all skin folds
- 2-person bag-mask
- Needle decompression/chest tube placement
- “Awake” intubation vs RSI
- Longer recovery time with failed attempted intubation
- Neck circumference
  - >60cm has 35% failed intubation attempt

(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

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Circulation

CHALLENGES

- Adipose tissue
- Lacking carotid and femoral pulse landmarks
- Non-hypertension state
  - Hypertension – CHF
  - Normotension may be hypotension
  - Pericardial tamponade
- Under-resuscitation
  - 55% less volume

(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

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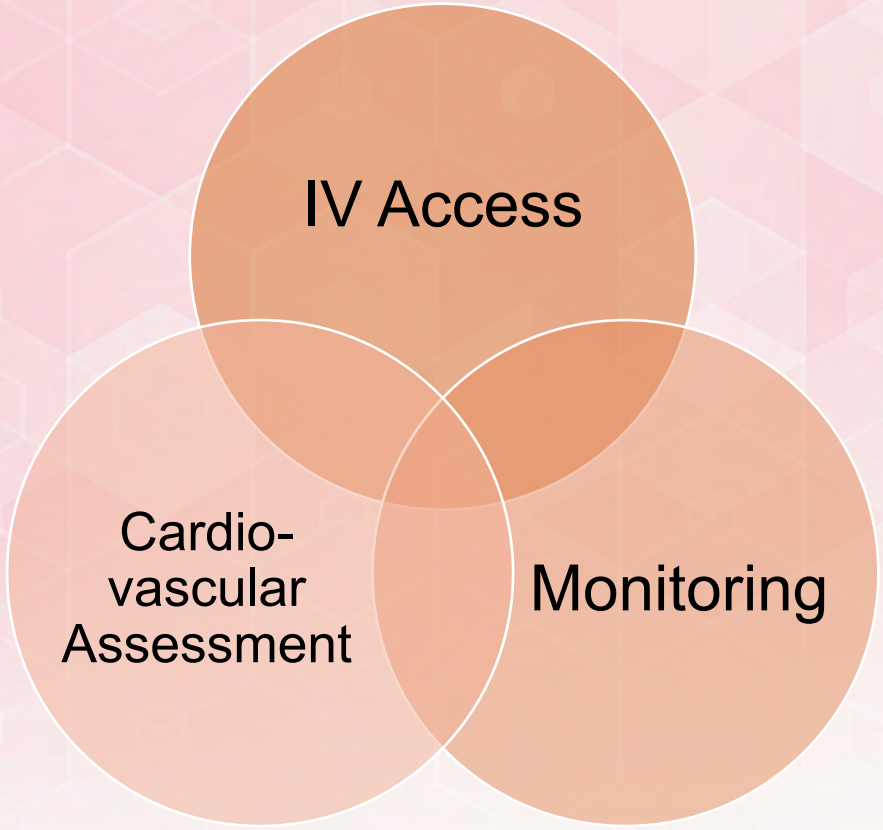
Circulation

CONSIDERATIONS

- IV access
  - Longer needles
  - Use of intra-osseous needle
  - Protection
- Monitoring
  - Intra-abdominal hypertension
- Cardiovascular assessment
  - Lactate
  - pH
  - PA catheter
  - Transesophageal echocardiogram



(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

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Disability

CHALLENGES

- Sleep apnea – somnolence
- Difficult to determine GCS
- Lack of mobility
- Airway problems with less neurological impairment
- Medications

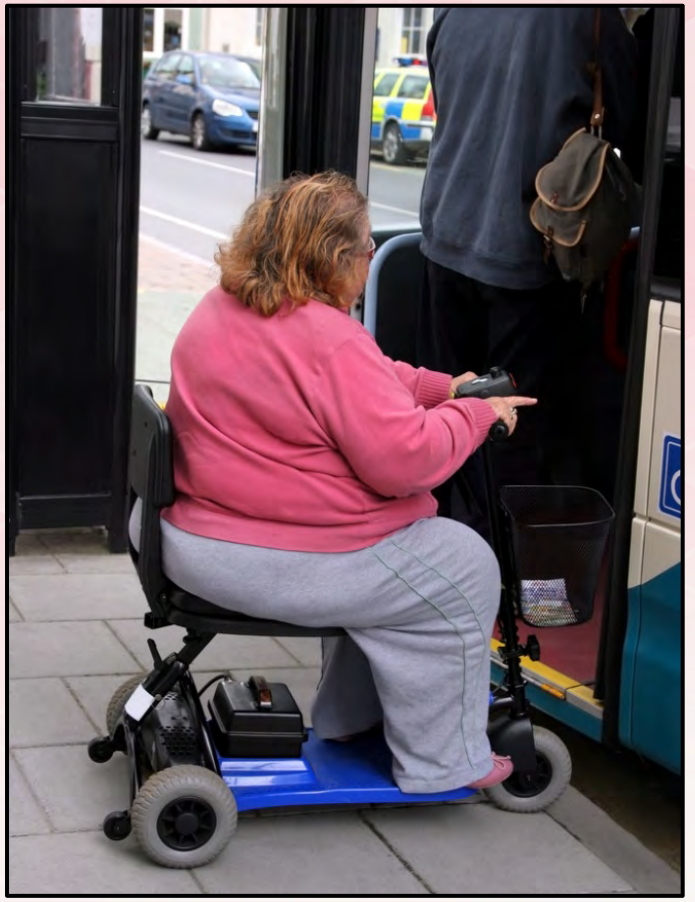
(Greenberger & Werman, 2014)

Disability

CONSIDERATIONS

- Close monitoring of GCS
- Early discharge planning
- Establish baseline

(Greenberger & Werman, 2014)



marilyn barbone / Shutterstock.com

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Exposure/Environment

CHALLENGES

- Skin shearing
- Hypothermia
- Longer entrapment times
- Inspect for skin rashes, fungal infections, decubitus, wounds
- Large pannus

(Greenberger & Werman, 2014)

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Exposure/Environment

CONSIDERATIONS

- Larger patient gowns
- Moving boards
- Assistance
- Stretchers/beds

(Greenberger & Werman, 2014)

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Primary Survey Adjuncts

CONSIDERATIONS

- Penetrating
- Weight limits
- Transport
- More aggressive
  - Blunt abdominal trauma

(Greenberger & Werman, 2014)

Secondary Survey

CHALLENGES

- Large arms
- ECG variations
- Thick fingers
- Abdominal weight

(Winfield & Bochicchio, 2013)

Secondary Survey

CONSIDERATIONS

- Normotension may be hypertension
- Mark cardiac probes
- Pulse ox probe to earlobe
- Need for gastric tube
- Need for urinary catheter
- Nosocomial infections
- Use of doppler

(Winfield & Bochicchio, 2013)

Give Comfort

CHALLENGES

- Patient size
- Bias
- Stigma
- Psychosocial issues

(Greenberger & Werman, 2014)

Give Comfort

CONSIDERATIONS

- Addressing bias may be first step to improving outcomes
- Medications
  - Right dose
  - Right route
- Specialized beds and equipment

(Greenberger & Werman, 2014)

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Head to Toe Assessment/History

Assessment

- Inspection
- Auscultate
- Palpate
- Lost landmarks

History

- Pre-hospital
- Referring Facility
- Medications
- Co-morbidities
- Surgeries

(Greenberger & Werman, 2014)

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Inspect Posterior Surfaces

CONSIDERATIONS

- Number of people needed to log roll
- Patient safety
- Bed width
- Skin folds

(Greenberger & Werman, 2014)

Caveats

- Disposition
- Post-operative care
- Missed injuries
- Fractures
- Morbidity
- Mortality
- Pharmacology
- Consultations

(Winfield & Bochicchio, 2013)

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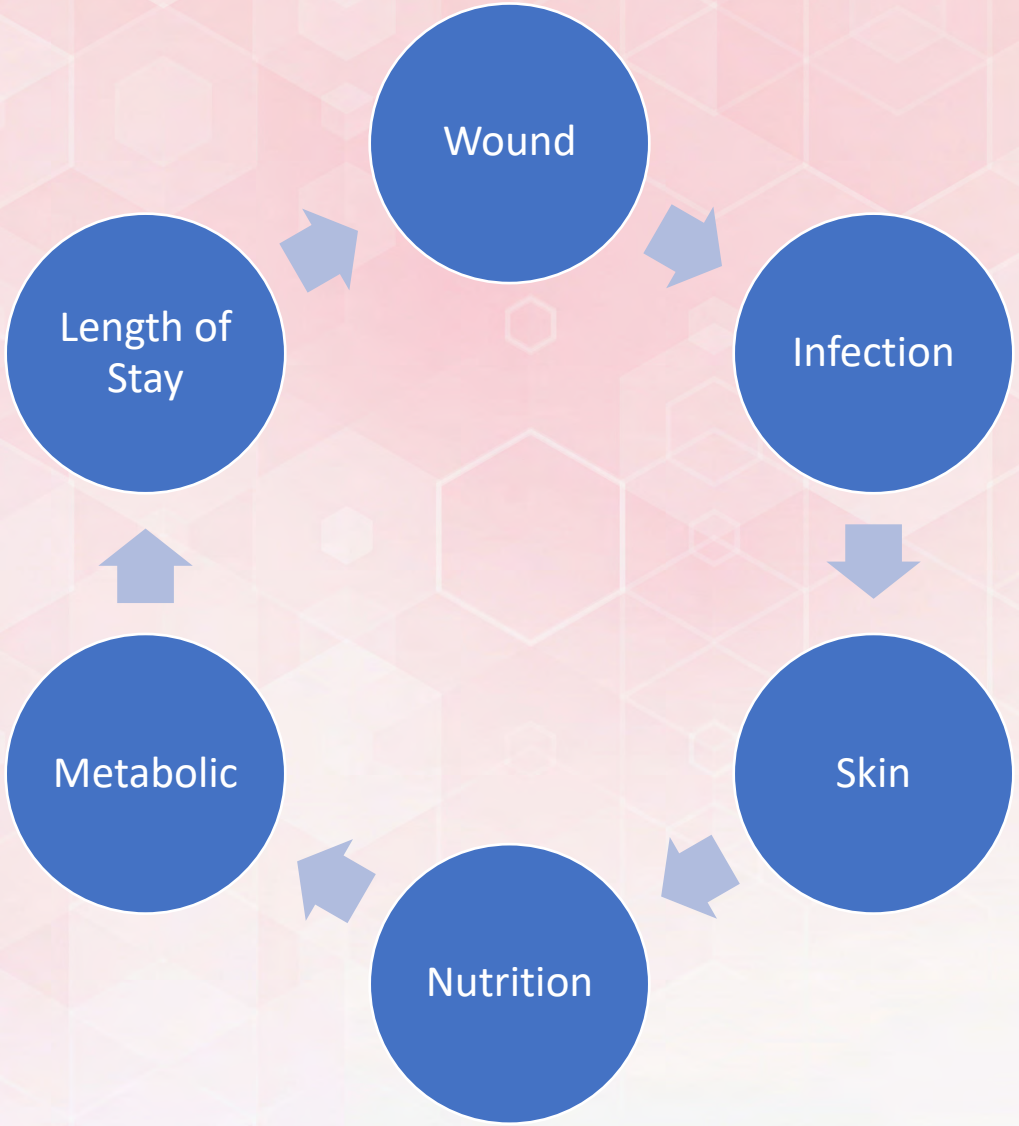
Disposition

- Decide early
- Make preparations to ensure patient safety
  - Interfacility
  - Intrafacility

(Osborn, Rowitz, Moore, Oliphant, Butler, Olsen, & Aucar, 2014)

Post-Operative Care



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Post Operative Complications

- Atelectasis
- Anastomotic leaks
- Increased thickness of stomas
- Higher risk of re-operation
- Higher infection rates
  - Delay fascial closure
  - Early symphyseal plating

Abdominal compartment syndrome can lead to hiatal hernia, gastric reflux, and aspirational pneumonia.

(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

Missed Injuries

- Sternal fractures
- Flail chest
- Pelvic fractures
- Rib fractures
- Pulmonary contusions

Limitations with traditional evaluations:

- FAST
- CT scan
- DPL
- Exploratory laporatomy

Missed injury vs delayed diagnosis

(Winfield & Bochicchio, 2013)

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Fractures

- Strength of rods
- Compartment syndrome
- Casting more difficult
- TLSO
- Vascular assessment challenges
- Higher rate of amputation
- Vitamin D insufficiency

Need for operative intervention up to 72% compared to 55% compared to normal weight patients.

(Greenberger & Werman, 2014)

Morbidity and Mortality

Morbidity

- Lack of primary care
- Isolation
- Non-compliance
- Higher rate of infection
- Increase rate of re-opertion

Mortality

- Multisystem organ failure
- Trauma brain injury
- Cardiac failure
- Respiratory arrest
- Pulmonary embolism

(Osborn, Rowitz, Moore, Oliphant, Butler, Olsen, & Aucar, 2014)

Pharmacology

- Drug effect considerations
  - Distribution
  - Renal clearance
  - Hepatic metabolism
  - Protein binding
- Common drugs
  - Antibiotics
  - Anti-thrombotics
  - Pain control

- Calculations
  - Dose weight (DW)
  - Ideal body weight (IBW)
  - Total body weight (TBW)

$$DW = IBW + 0.3 (TBW – IBW)$$

- Monitor/Monitor/Monitor

(Winfield & Bochicchio, 2013)

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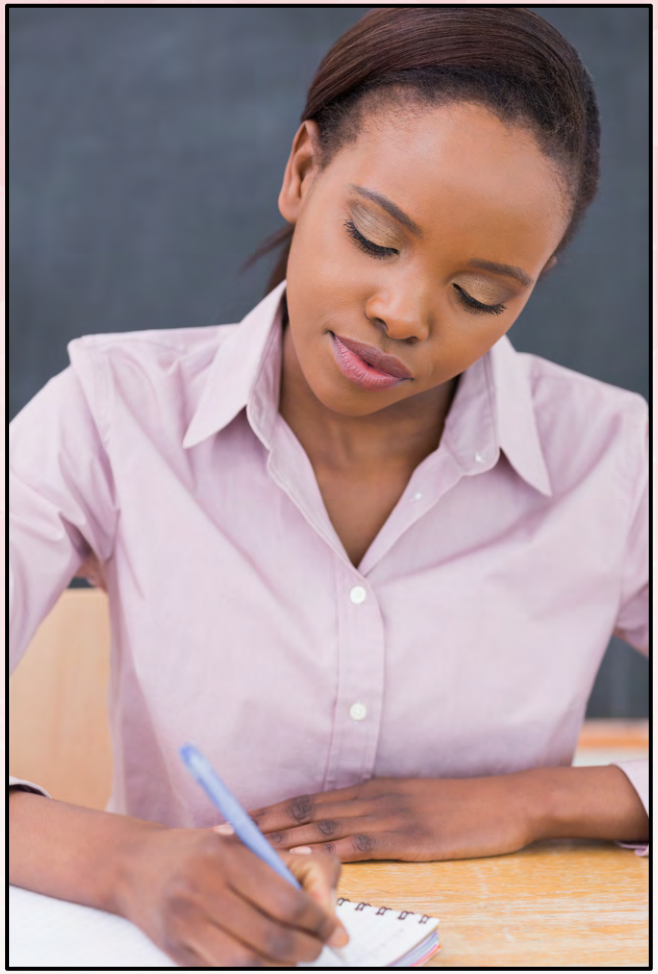
Consultations

- Nutrition
  - Hypocaloric
  - Higher protein
  - Prebiotics/probiotics
- Pharm D
- Primary care providers
- Case management
- Social work
- Sleep apnea



(Greenberger & Werman, 2014)

Review Guidelines/Policies/Plan

- Massive blood transfusion
- Pediatric
- Geriatric
- Burn
- Fracture
- Blunt Abdominal
- Pelvic
- TBI
- Dietary
- Team members
- Roles and Responsibilities
- Activation criteria
- Equipment
- PIPS
  - Outcomes
  - Root cause
- Education

(Twaij, Sodergren, Pucher, Batrick, & Purkayastha, 2013)

Functional Independence Measurement (FIM)

- Admission, discharge, 6 months post discharge
- Domains
  - Self-care
  - Sphincter control
  - Mobility
  - Locomotion
  - Communication
  - Social cognition
- Longer recovery with each unit of BMI, age, and ISS (48% longer)

(Dhungel, et al, 2015).

Labs to Watch

- BUN
- Creatinine
- Insulin levels
- Cortisol
- Hyperlipidemia
- PT/PTT
- C-reactive protein
- Cytokine
- Lactate
- Amylase/lipase
- ABG
- Anti-Xa
- Growth hormone
- Prolactin
- TSH

(Winfield & Bochicchio, 2013)

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Summary

- Obesity places challenges on healthcare costs by stressing infrastructure, requiring specialized equipment, and evidence based education.
- Obesity along impacts body systems thus increasing the complexity of trauma care.
- Research into trauma resuscitation principles is shifting acute and long term care of obese patients.
- Management of obese trauma patients is expanding to incorporate subspecialists and services.

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Chapter 14 - Pregnancy in Trauma Test Questions

1. A 22 year old female was involved in a motor vehicle crash (MVC). She is pregnant and states the gestational age of the fetus is 32 weeks. Her vital signs are: heart rate 89, blood pressure 127/54, respiratory rate 22, Sp02 is 100% on a non-rebreather at 15 LPM, GCS 15. After the primary assessment is completed (ABCD) the nurse expects to immediately:

    a. Transport the patient to radiology for a CT scan
    b. Place an indwelling urinary catheter
    c. Assist with fetal assessment
    d. Role the patient off the backboard and inspect the posterior surfaces

2. Pregnant women are most at risk for falls:

    a. During the 6, 7, 8th months of pregnancy
    b. During the 9th month of pregnancy
    c. During the 4th and 5th months of pregnancy
    d. The risk is equal throughout pregnancy

3. Which of the following is NOT true about blunt trauma in the pregnant patient:

    a. The placenta is not able to contract and expand with the uterus
    b. The first sign of maternal hemorrhage may be non-reassuring fetal heart tones
    c. Increased vascularity puts the mother at greater risk for hemorrhage
    d. The severity of injuries is a good predictor for placental abruption

4. Hemorrhagic shock in a pregnant trauma patient may lead to:

    a. Pituitary insufficiency
    b. Fetal demise
    c. Fetal bradycardia
    d. All of the above

5. The Kleihauer-Betke test is used to test for:

    a. Fetal maturity
    b. Transplacental hemorrhage
    c. Mothers Rh status (negative or positive)
    d. The presence of disseminated intravascular coagulopathy (DIC)

6. Which woman is more at risk for intimate partner violence, based on current statistics:

    a. African American, 25 year old woman, bachelor degree, 1st pregnancy, married
    b. 19 year old Mexican woman, 8th grade education, 2rd pregnancy, unmarried with a live in boyfriend
    c. 17 year old Caucasian woman, currently in high school, 1st pregnancy, lives at home with her parents
    d. Asian, 43 year old woman, high school education, 1st pregnancy, unmarried.

7. The cardiovascular changes associated with a normal pregnancy are:

    a. Increased heart rate, decreased systemic vascular resistance (SVR) and an increase in blood volume
    b. Increased blood pressure, decreased hematocrit, and increased heart rate
    c. Decrease in cardiac output, decrease in blood pressure and decrease in systemic vascular resistance (SVR)
    d. Increase in blood volume, increase in hematocrit and an increase in cardiac output

8. Normal pregnancy has two of the three factors of Virchow's Triad, in the pregnant trauma patient, endovascular trauma comprises the last of the three factors, making the patient at risk for:

    a. Low hematocrit
    b. Acidosis
    c. Alloimmunization
    d. Deep vein thrombosis (DVT)

9. When screening for intimate partner violence in the pregnant patient, the best method is:

    a. A pen and paper questionnaire
    b. Call social work because they are familiar with this role
    c. After asking the partner to step out, ask a single direct question, such as “Within the past year -- or since you have been pregnant -- have you been hit, slapped, kicked or otherwise physically hurt by someone?”
    d. Ask the patient if she has something she wants to talk about.

10. When resuscitating the pregnant trauma patient which step should be completed first?

    a. Begin infusing normal saline at a wide open rate
    b. While maintaining spinal precautions, place the patient in a left tilt at 15 degrees or 4-6 inches.
    c. Assess fetal heart tones
    d. Place two large bore IV’s

Chapter 14 - Pregnancy in Trauma Answer Key

1. c
2. a
3. d
4. d
5. b
6. b
7. a
8. d
9. c
10. b

Chapter 15 - General Concepts in Pediatric Trauma Care
Test Questions

1. Young children have a larger head in proportion to the rest of their body. In light of this which statements are true?

    a. The child's head/body proportion becomes the same as an adult's by age 10
    b. The large head causes the child to have a lower center of gravity
    c. A young child is likely to hit their head when they fall over the handlebars of a bike.

2. A child comes into the ED after a frontal collision motor vehicle crash. Pre hospital care states the child is 11 months old and was in a front facing car seat in the back of the car. What injuries would you look for?

    a. None since the child was properly restrained.
    b. Leg fractures from the child hitting his legs against the back seat.
    c. Neck injuries since he was front facing

3. An 8 year old child is brought to their pediatrician with abdominal pain. The Mom states that the child fell from his bike yesterday. On exam he only has a small round mark on the upper right quadrant of his abdomen. His pulse is 130 and he is slightly pale. He is listless and complaining of abdominal pain. The pediatrician should:

    a. Send the boy home and tell him to rest. He probably has the flu
    b. Send the boy to the ED of a local trauma center immediately, preferably one with pediatric capabilities
    c. Refer the child to a local surgeon for work up of an acute abdomen

4. What factors may impact outcomes of the pediatric TBI patient?

    a. Control of hypovolemia.
    b. Control of Intracranial Pressure
    c. Use of ventilation strategies
    d. All of the above

5. Which statement is false regarding spinal injuries in pediatric patients?

    a. Cervical spine injuries uncommon in younger children
    b. Spinal cord injury may occur without radiographic evidence
    c. Pediatric patients <11 years old have strong neck muscles
    d. Mortality is increased due to secondary brain injury

6. What is the one physiologic aspect of a child's thorax that makes an injury pattern different than an adult with similar mechanism of injury?

    a. Smaller body mass
    b. Smaller blood volume
    c. Decreased thorax compliance
    d. Greater gastric distention

7. What is the one physiologic aspect of a child's abdomen that makes an injury pattern different than an adult with similar mechanism of injury?

    a. Thinner musculature
    b. Greater rib compliance
    c. Relative size of intra-abdominal organs
    d. Lower relative fat content

8. What is the development stage/goal for the preschool age child?

    a. Trust versus mistrust
    b. Industry versus inferiority
    c. Initiative versus guilt
    d. Autonomy versus shame

9. Which statement is true about pain in infants and children?

    a. Infants have immature nervous systems and do not perceive pain as much as older children and adults do.
    b. Children must be at least 7 years old to be able to rank their pain level using a validated tool.
    c. There is no long-consequence to untreated pain in infants and children.
    d. Infants and children experience pain and should be appropriately assessed for pain using a validated pain scale/tool

10. What fact is true about child abuse versus unintentional injury fatality rates?

    a. Fatality rates are identical.
    b. Fatality rates are higher in child abuse patients than in those with unintentional injury.
    c. Fatality rates in patients with unintentional injuries are higher than in child abuse.

Chapter 15 - General Concepts in Pediatric Trauma Care
Answer Key

1. c
2. c
3. b
4. d
5. c
6. c
7. d
8. c
9. d
10. b

Chapter 16 - Geriatric Trauma Test Questions

1. What is the leading cause of injury for those aged >65 years?

    a. MVC
    b. Suicide
    c. Pedestrian vs. Car
    d. Fall

2. Possible causes of falls include

    a. Polypharmacy
    b. Alcohol
    c. Dizziness
    d. All the above

3. Age-related decline in which of the following systems can have a negative impact on recovery from trauma in the elderly

    a. Neurologic
    b. Renal
    c. Cardiac
    d. All of the above
    e. None of the above

4. Diminished pulmonary reserve causes

    a. Less oxygen available for extraction during times of increased need
    b. Pneumonia
    c. ARDS
    d. Hypotension

5. The gold standard for imaging choices in the majority of occult hip fractures is

    a. Plain-film x-ray
    b. MRI
    c. CT
    d. Bone scan

6. Rapid warfarin reversal protocols

    a. Significantly decrease mortality in patients with intracranial bleeds who are on warfarin
    b. Are difficult to implement
    c. Do not change outcomes
    d. Are effective in patients on anti-platelet medications

7. The most common cause of cervical spine injuries in the elderly is

    a. Same level falls
    b. MVC
    c. Fall down stairs
    d. Pedestrian vs. car

8. Halo vests as a treatment option in elderly patients with cervical fractures are associated with

    a. Improved outcomes
    b. Increased risk of complications and death
    c. Increased transfers to Level 1 Trauma Centers
    d. Improved nutrition

9. Treatment modalities associated with improved outcomes in elderly patient with rib fractures are
    a. Pain control
    b. Trauma consultation
    c. Incentive spirometry
    d. All the above

Chapter 16 - Geriatric Trauma Answer Key

1. d
2. d
3. d
4. a
5. a
6. a
7. a
8. b
9. d

Chapter 17 - Burn and Inhalation Injury Test Questions

1. Mr. Zimmer arrives in your emergency department with burns to his face, chest and arms from an explosion in his basement. He presents with shortness of breath and chest pain. What is your priority intervention?

    a. Assess his airway
    b. Cover the burns
    c. Monitor his cardiovascular status
    d. Intubate him because he's probably got an inhalation injury

2. A 35 year old patient arrives to your emergency department with 57% total body surface area burns due to electrical injury. Important considerations for this patient include all of the following except:

    a. Monitor EKG for dysrhythmias
    b. Observe for hemoglobinuria
    c. Fluid resuscitation with goal of 30cc urine output per hour
    d. Monitor for compartment syndrome

3. Mr. Sampson was working on his car when he accidently poured gasoline on the engine and it exploded. He has burns over 80% of his body and his weight is 100Kg. Please calculate his fluid needs for the first 24 hours:

    a. 8,000cc
    b. 12,000 cc
    c. 20,000 cc
    d. 32,000 cc

4. If a patient has evidence of facial swelling and soot in the oral passages, what management option should be considered?

    a. Early intubation
    b. High flow oxygen
    c. Monitoring of respiratory status with pulse oximetry
    d. Admission to the burn unit

5. Indications for referral to a burn center include all of the following except:

    a. All pediatric patients
    b. Facial burns
    c. Full thickness burn 4% TBSA
    d. Second-degree burns < 8% TBSA

6. What can one anticipate immediately after a major burn?

    a. Airway compromise
    b. Increased vascular permeability resulting in myocardial depression
    c. Decreased peripheral vascular resistance
    d. Decreased blood viscosity

7. All of the following are interventions to reverse the effects of hypothermia except:

    a. Rewarm the patient
    b. Provide fluid resuscitation
    c. Correct metabolic imbalances
    d. Prepare for autologous grafting

8. Cleansing of the burn wound should entail use of:

    a. Water only
    b. Betadine scrubs
    c. An antibacterial agent
    d. A topical antimicrobial

9. Children age < 2 years require more fluid resuscitation than adults.
    a. True
    b. False

10. What is the primary wound covering method for full thickness burns?

    a. Biologic dressings
    b. Autografts
    c. Enzymatic debridement creams
    d. Hydrocolloid dressings

Chapter 17 - Burn and Inhalation Injury Answer Key

1. a
2. c
3. d
4. a
5. d
6. b
7. d
8. c
9. T
10. b

Chapter 18 - General Principles in the Care of the Obese Trauma Patient Test Questions

1. Identify at least six challenges to consider when caring for critically injured obese trauma patients.
2. What is the definition of morbid obesity?
3. Describe four co-morbidities associated with obesity.
4. List three factors that lead to increased morbidity and mortality in the critically injured obese patient.

Chapter 18 - General Principles in the Care of the Obese Trauma Patient Answer Key

1. Pre-hospital care , Personnel, Equipment, Transport, MOI, Assessment
2. Adjuncts, Mortality/Morbidity, Pharmacology
3. Morbid Obesity: a BMI of 40 or more
4. Cancer, GB disease, Renal failure, Stroke, Heart failure, Atherosclerosis, NIDDM, Hypertension
5. Lack of primary care, isolation, non-compliance