

# Pediatric Emergencies

## Trauma

Guy Peifer



# Objectives

- Just one.....
- Learn to better handle a pediatric trauma emergency.



# A Little Anatomy & Physiology

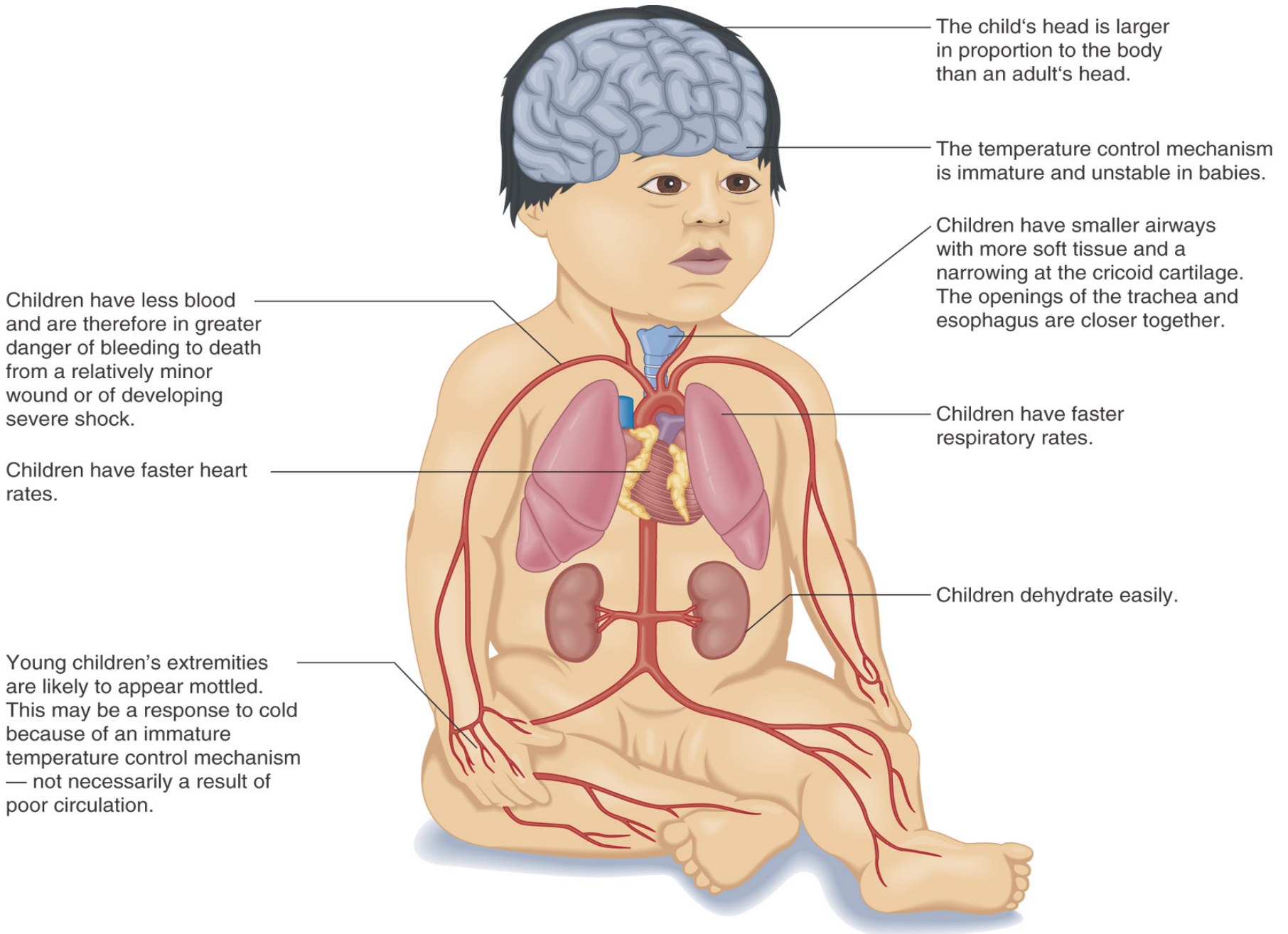
- Head larger in proportion to the body
- Occipital region significantly larger
- Small face / Flat nose – difficult to obtain mask seal
- Smaller airways
- Breathe faster
- Dehydrate easily



# A Little More Anatomy & Physiology

- Small airway
- Nose & diaphragmatic breathers
- Immature temperature control mechanism
- Soft bones
- Thin chest walls
- Increased liver & spleen injury





The child's head is larger in proportion to the body than an adult's head.

The temperature control mechanism is immature and unstable in babies.

Children have smaller airways with more soft tissue and a narrowing at the cricoid cartilage. The openings of the trachea and esophagus are closer together.

Children have less blood and are therefore in greater danger of bleeding to death from a relatively minor wound or of developing severe shock.

Children have faster respiratory rates.

Children have faster heart rates.

Children dehydrate easily.

Young children's extremities are likely to appear mottled. This may be a response to cold because of an immature temperature control mechanism — not necessarily a result of poor circulation.

## Still Some More A & P

- Soft bones
- Growth plate
- Skin: thin, less subcutaneous tissue,  $>$  BSA:weight
- Increased O<sub>2</sub> demand / Less reserve
- May be in shock despite good BP
- Limited glucose supply

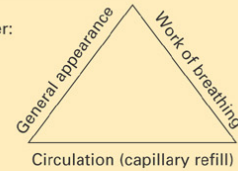


## BASICS OF PEDIATRIC ASSESSMENT

### Initial Assessment

Forming a general impression. Elements to consider:

- Skin color
- Quality of cry or speech
- Interaction with surroundings
- Emotional state
- Response to the EMT
- Body tone and positioning



### Determining Mental Status

- AVPU scale

### Assessing ABCs

- Observe the respiratory rate.
- Observe for full and symmetrical chest rise with inspiration.
- Note the effort or work of breathing. Look for:
  - Retractions
  - Nasal flaring
  - “Seesaw” breathing
- Listen for audible abnormal breathing sounds.
  - Grunting
  - Stridor
  - Crowing
  - Other noisy breathing.
- Listen with a stethoscope to both sides of the chest.
- Assess peripheral perfusion.
  - Feel for brachial, femoral, and peripheral pulses.
  - Check capillary refill in children 5 years of age or younger.
- Assess the skin for color, moisture, and temperature.
- Take a blood pressure reading in children older than 3 years.

### History and Physical Exam

#### Common Medical Problems

- Airway obstruction
- Respiratory emergencies
- Seizures
- Altered mental status
- Fever
- Poisonings
- Shock
- Near drowning
- Sudden infant death syndrome (SIDS)

#### Common Trauma Situations

- Seat belt injuries
- Bicycle-related injuries
- Car vs. pedestrian injuries
- Head and neck injuries
- Burns
- Abuse and neglect



# Vital Signs

- What's "normal"
- $80 + 2x$  age
- Minimum  $70 + 2x$  age
- $40 - \text{age} =$  upper limit of respiratory rate
- Think of weight as a vital sign
  - ›  $2x \text{ age} + 8 = \text{kg}$





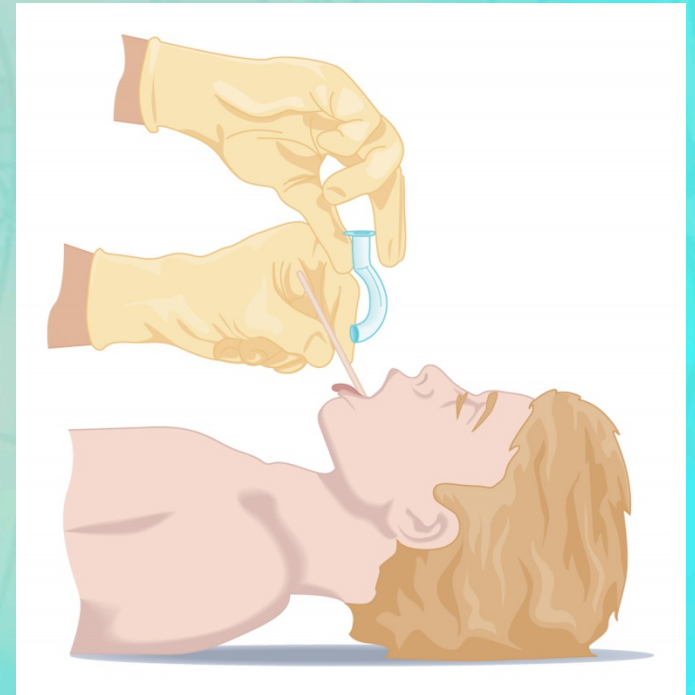
# Diagnostics

- Vitals
- ECG
- Blood Glucose
- Temperature
- Pulse Oximetry
- Capnography



# Airway Management

- Modified Jaw Thrust
- OPA / NPA
- “To Tube or Not to Tube”
  - Room air
  - Blow-by
  - Nasal Cannula
  - Non-Rebreather

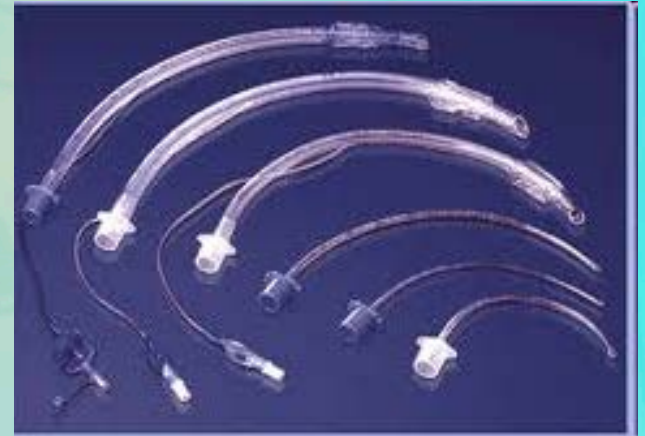


# Ped and Adult Normal Trachea



# Advanced Airway

- Intubation
  - Oral vs Nasal
  - Visual vs Blind
  - Cuffed vs Uncuffed
- LMA
  - Does not protect against aspiration



# Advanced Airway

- KING
  - Size 2, 35-45 inches, (90-115 cm) in height or 12-25 kg in weight
  - Size 2.5, 41-51 inches, (105-130 cm) in height or 25-35 kg in weight
- Dual Lumen
  - Not used
- Needle Cric/Surgical Airway
  - Indicated when no other airway is available



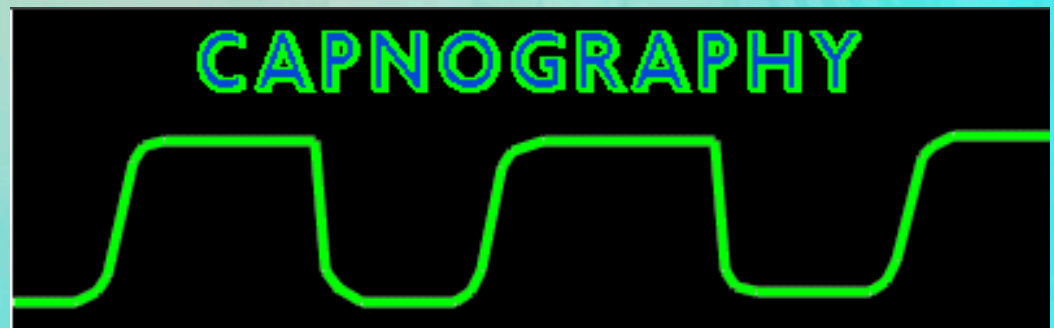
# Intubation

- ET Tube Size
  - $16 + \text{age}/4$
  - $\text{Age}/4 + 4$  (uncuffed)
  - $\text{Age}/4 + 3$ 
    - Limit ET Tube cuff inflation pressure to 20 cm H<sub>2</sub>O
- Insertion Depth = 3x tube diameter
- Straight vs Curved Blade?



# How Do You Confirm ET Tube Placement?

- Visualize
- Chest Rise
- Auscultation
- Heart rate changes
- Capnography
- Pulse Oximetry



# Pediatric Trauma

- Falls
- Motor Vehicle Crashes
- Struck by Vehicle
- Penetrating Injuries
- Burns
- Abuse





# Pediatric Head Injury

↑ Cerebral edema & ICP with severe closed head injury

Greater head surface area & open fontanelle

Big Head vs Little Body

Weak neck muscles



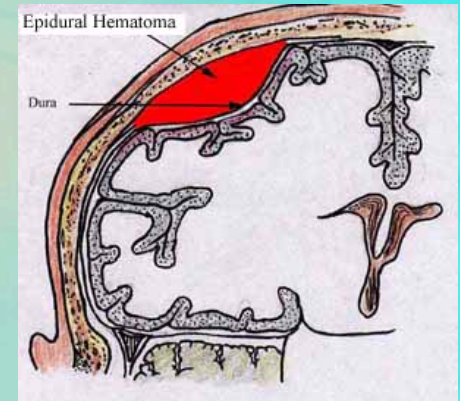
# What Does the Brain Want?

1. Blood
2. Oxygen
3. Glucose



# Increased Intracranial Pressure

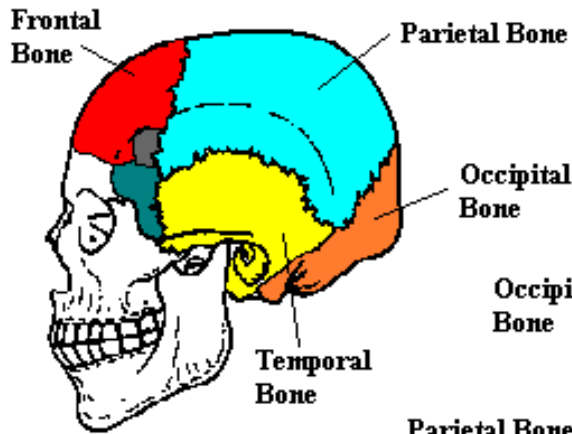
- Elevated BP
- Widening Pulse Pressure
- Bradycardia
- Resp. changes
  - Central Neurogenic Hyperventilation
  - Cheyne Stokes
  - Ataxic



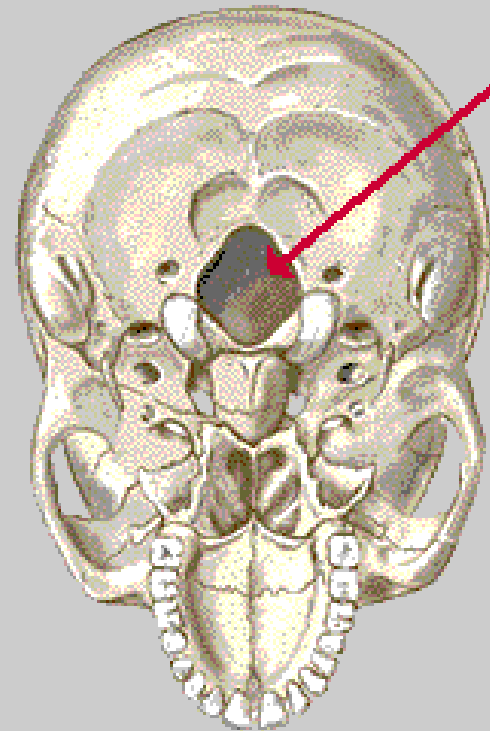
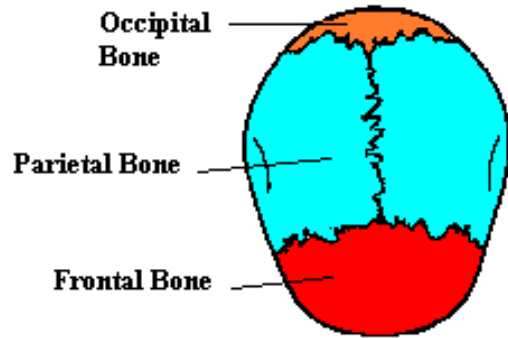
Airflow



Side View



Top View



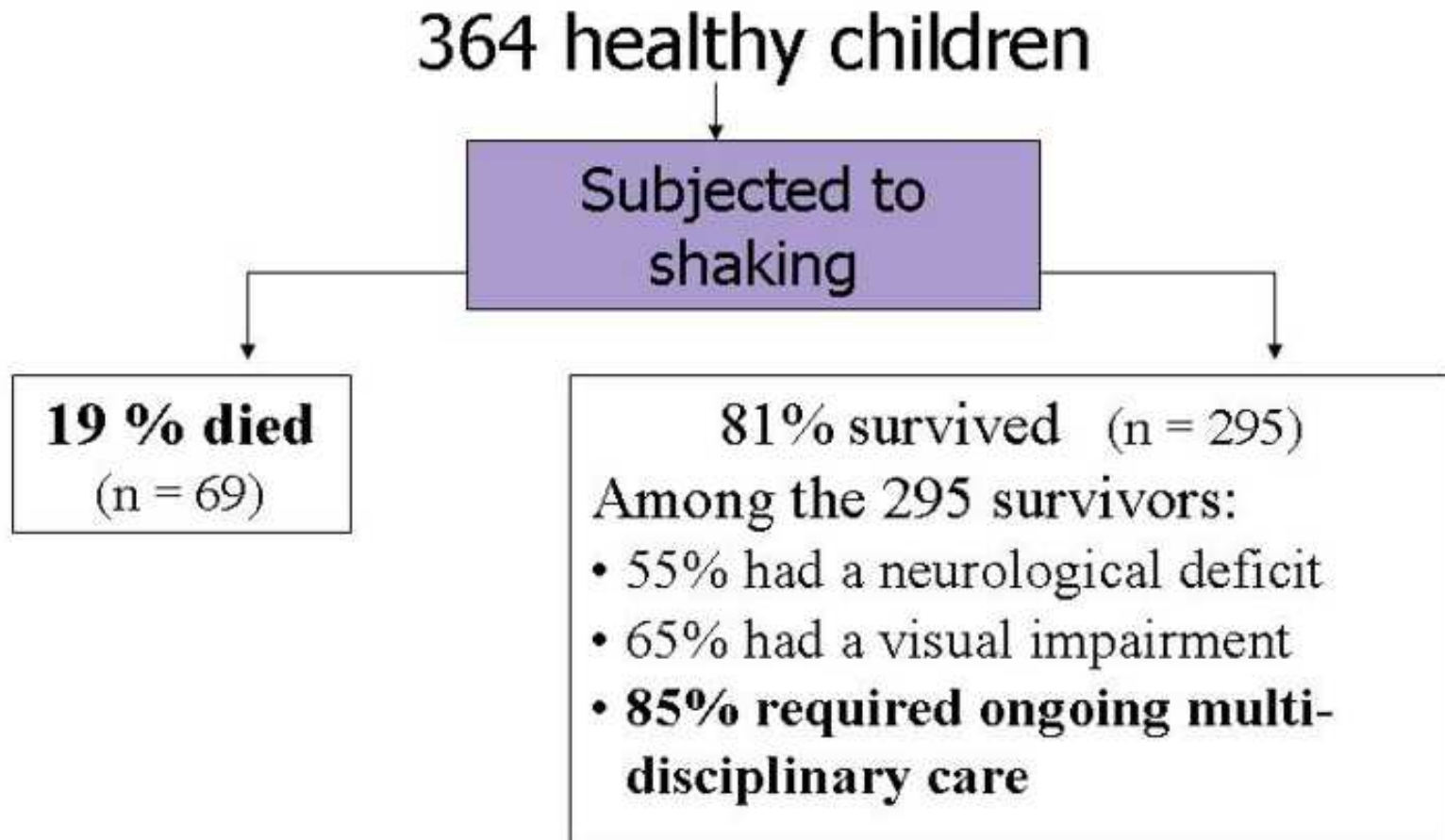
# Skull Fractures

- 400 times increased risk of traumatic brain injury
- Linear / Depressed / Basilar
- Basilar
  - Raccoon eyes
  - Battle sign
  - CSF



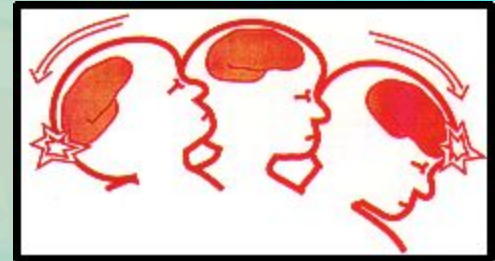
*Fig. 1. Bilateral periorbital ecchymosis (raccoon eyes) and mild proptosis.*

# Shaken Baby Syndrome



# Shaken Baby Syndrome

- Produces forces up to 9.3G
  - Roller Coaster 3-4G
  - Fighter Pilot 6G
  - Child struck against solid object up to 428G



- Symptoms
  - Vomiting
  - Failure to thrive
  - AMS
  - Seizures

- Classic Triad
  - Cerebral edema
  - Retinal Hemorrhage
  - Subdural Hemorrhage



**Table 1 Modified Glasgow coma score**

Score	Response	Response	Response
<i>Eye opening</i>			
4	> 1 year Opens spontaneously	0–1 year Opens spontaneously	
3	Opens to a verbal command	Opens to a shout	
2	Opens in response to pain	Opens in response to pain	
1	No response	No response	
<i>Best motor response</i>			
5	> 5 years Oriented and able to converse	2–5 years Uses appropriate words	0–23 months Cries appropriately
4	Disoriented and able to converse	Uses inappropriate words	Cries
3	Uses inappropriate words	Cries and/or screams	Cries and/or screams inappropriately
2	Makes incomprehensible sounds	Grunts	Grunts
1	No response	No response	No response
<i>Best verbal response</i>			
6	> 1 year Obeys command	0–1 year Spontaneous	
5	Localizes pain	Localizes pain	
4	Flexion withdrawal	Flexion withdrawal	
3	Flexion abnormal (decorticate)	Flexion abnormal (decorticate)	
2	Extension (decerebrate)	Extension (decerebrate)	
1	No response	No response	



# Messing up the Glasgow Score

- Intubation
- Swollen eyes
- Paralysis
- Sedation
- “Nap Time”



Remember... Pupils are the windows to the brain !!



# Scenario

Your Sunday football game is interrupted by the tones alerting you to a child struck by an auto.

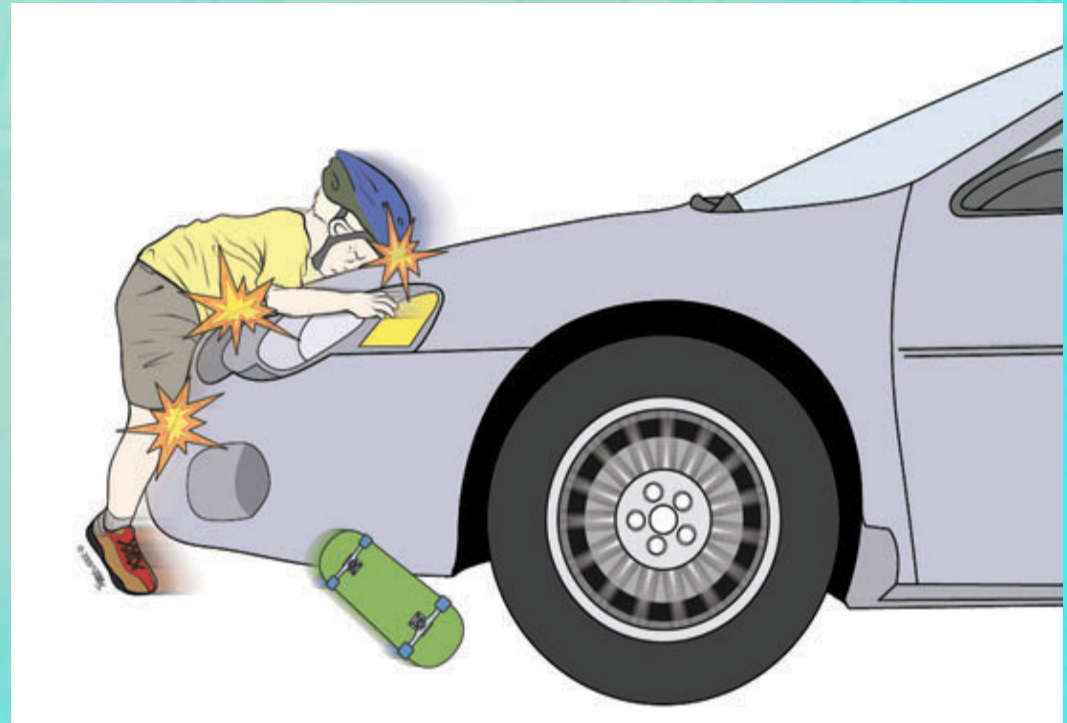
Upon arrival you find a 6-year-old male unresponsive and bleeding from the mouth.

Initial management?



# Waddell's Triad

- Predictable injury pattern
- Initial Impact
  - Blunt trauma to abdomen, pelvic, femur
- Second Impact
  - Thoracic trauma
- Third Impact
  - Head Trauma



# Upon Assessment

- Responds to pain by moaning
- Airway
  - Blood flowing in mouth
  - Gurgling noted
- Breathing
  - Rapid
  - Irregular
- Circulation
  - Slow, bounding radial pulse
  - Skin is warm & dry
  - No other bleeding noted



# Assessment Continued

- Disability / Diagnostics
  - Rapid Treat/Transport
  - GCS = 8
  - Vitals
    - 140/90
    - HR 66 reg & bounding
    - RR assisted @ 20
    - Pulse Oximetry 95%
    - Dilated, Sluggish to react
  - Expose



# Assessment Continued

- Rapid Head-to-Toe
  - Hematoma Right temporal region
  - Facial abrasions
  - Trachea midline, no JVD, no c-spine deformity
  - Abdomen soft, pelvis stable
  - Left Femur deformed
  
- Focused Hx



# Where are you going with this patient?

- Closest hospital
- Trauma Center
  
- Ground
- Air

Ongoing Assessment?





Lets review treatment modalities?



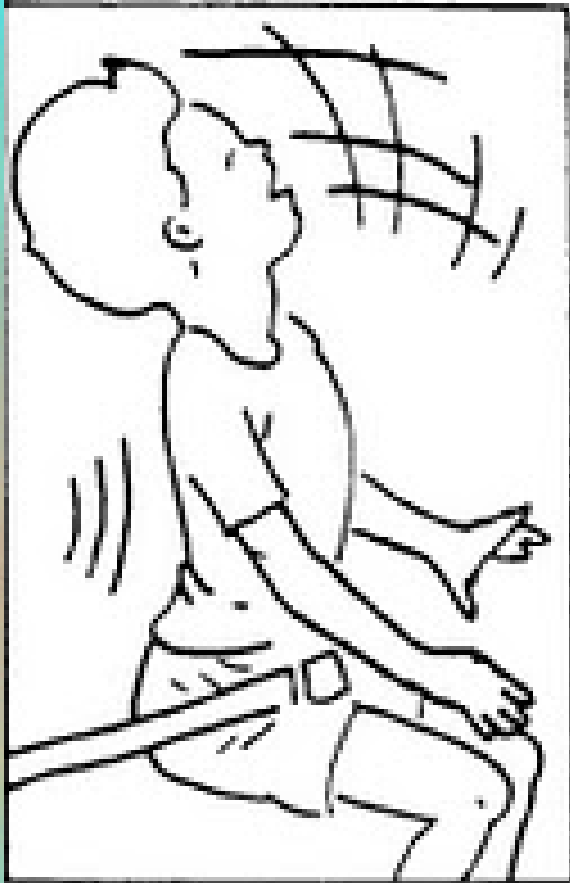
# Spinal Cord Injuries in Peds

- MVC's, Diving/Falls, Sports
- Big head / Little body
- SCIWORA (spinal cord injury without radiographic abnormality)
- Cord Injuries
  - < 8 years old C1-C4
  - 8-12 years old transitional
  - > 12 years old C4-C7

Neck ligaments in children are more lax, resulting in spinal cord damage even in the absence of boney structure disruption.



Hyperextension



Hyperflexion



Distraction

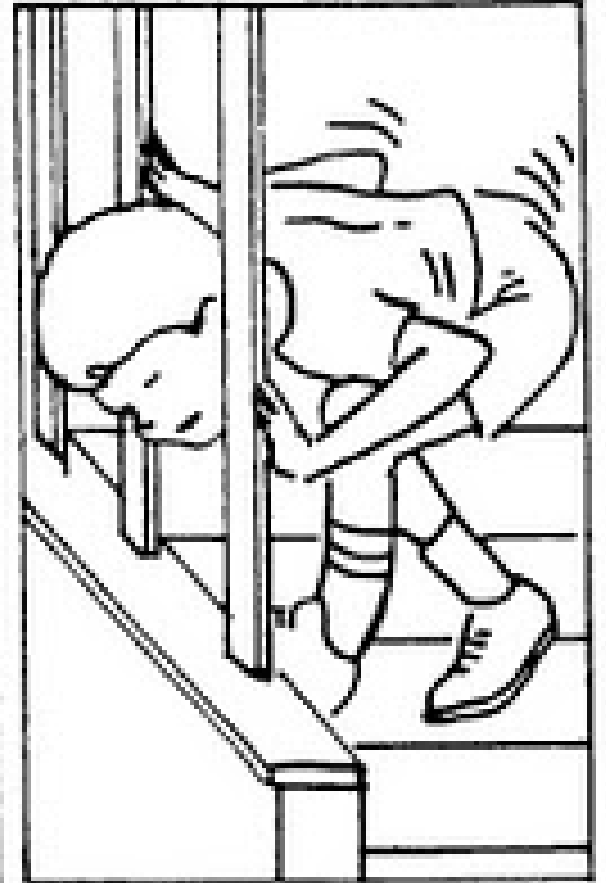


Figure 1. Mechanisms of injury associated with SCIWORA.



“In God we trust...All others get a spine board” - ????????

Rowley Cottingham

# Diagnosis of Spinal Cord Injuries

- Mechanism of Injury
- History
- Presentation / Exam



Figure 8. Atlanto-occipital dislocation.

# Spinal Shock

- Think.....
  - Tank
  - Pump

Treatment:

Do no further harm

ABC's

Spinal Motion Restriction

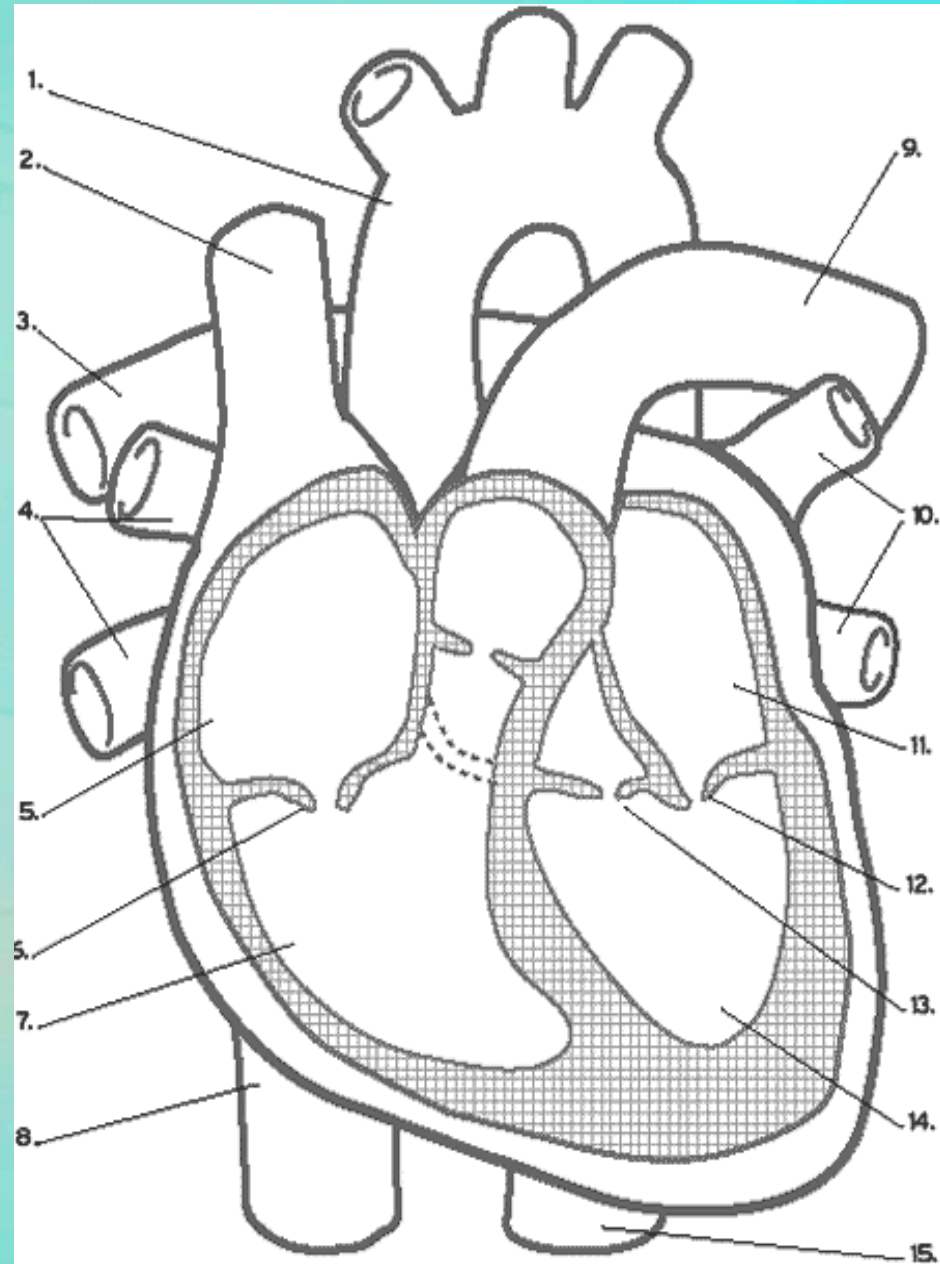
Fluid

Meds (pain)

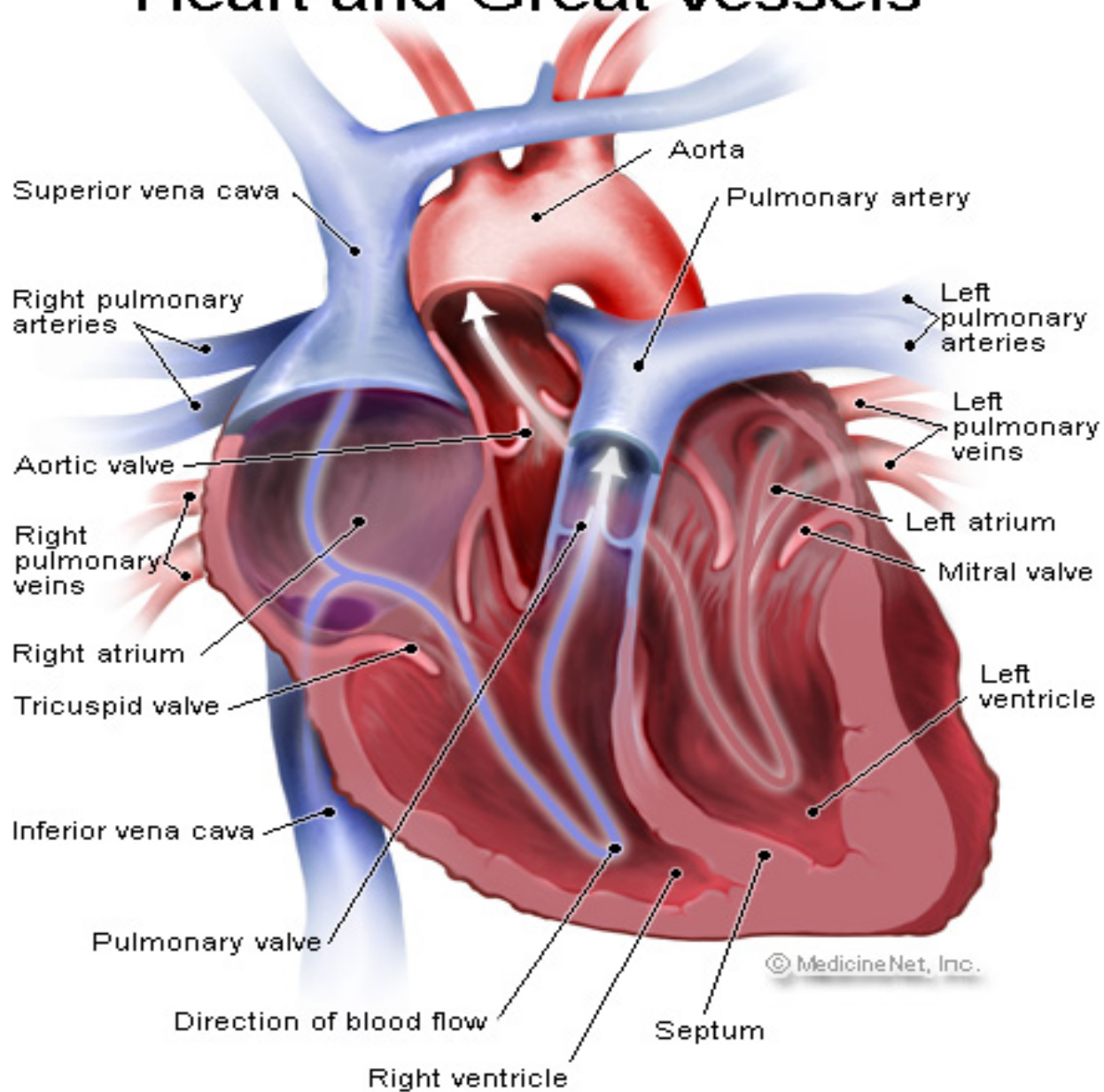


# Chest Trauma

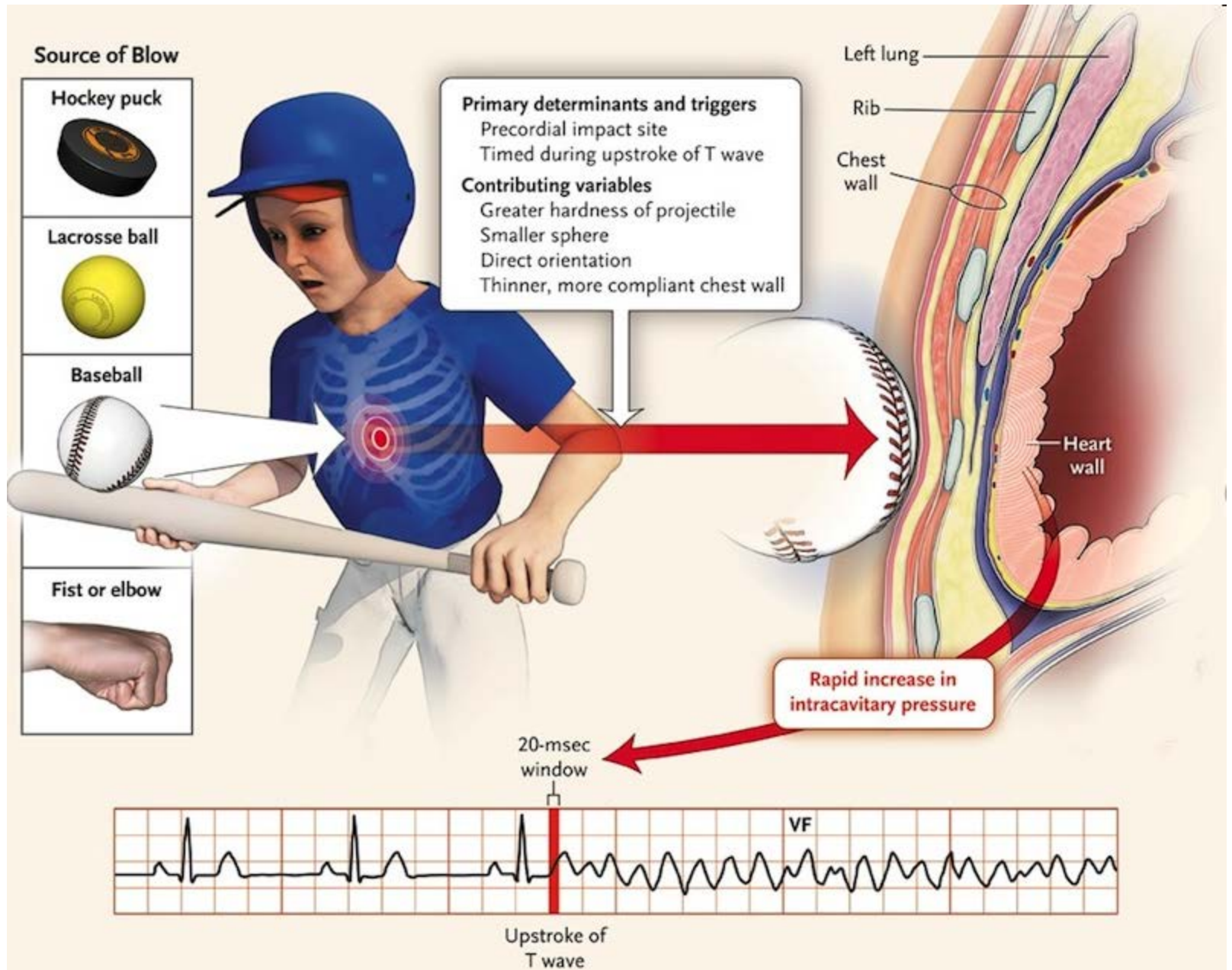
- Anatomy
- Blood goes.....
- Air goes.....
- Pliable chest wall
- Mechanism of Injury
  - Blunt
  - Penetrating



# Heart and Great Vessels



# Commotio Cordis





# Rib Fractures

- Causes?
- Signs/Symptoms
- What rib(s) are fractured?
  - 1<sup>st</sup> & 2<sup>nd</sup> rib – possible vascular injury
  - Left lower ribs – splenic injury
  - Right lower ribs – liver injury
- Management



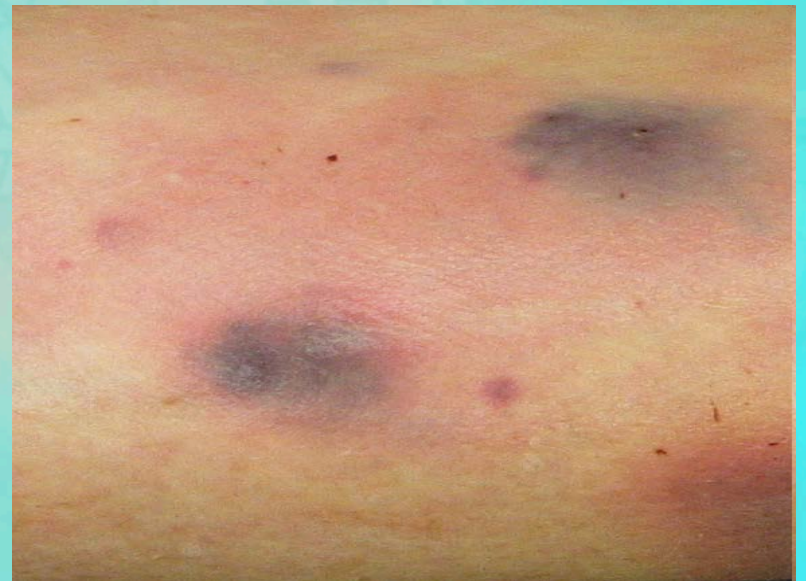
# Managing Rib Fractures

- Focus on airway maintenance and supplemental oxygen.
- Clear pulmonary secretions.
- Consider pain relief.
- Rib belts or binding do control pain, they have been linked to hypoventilation, atelectasis, and pneumonia. As a result, their use is no longer recommended.

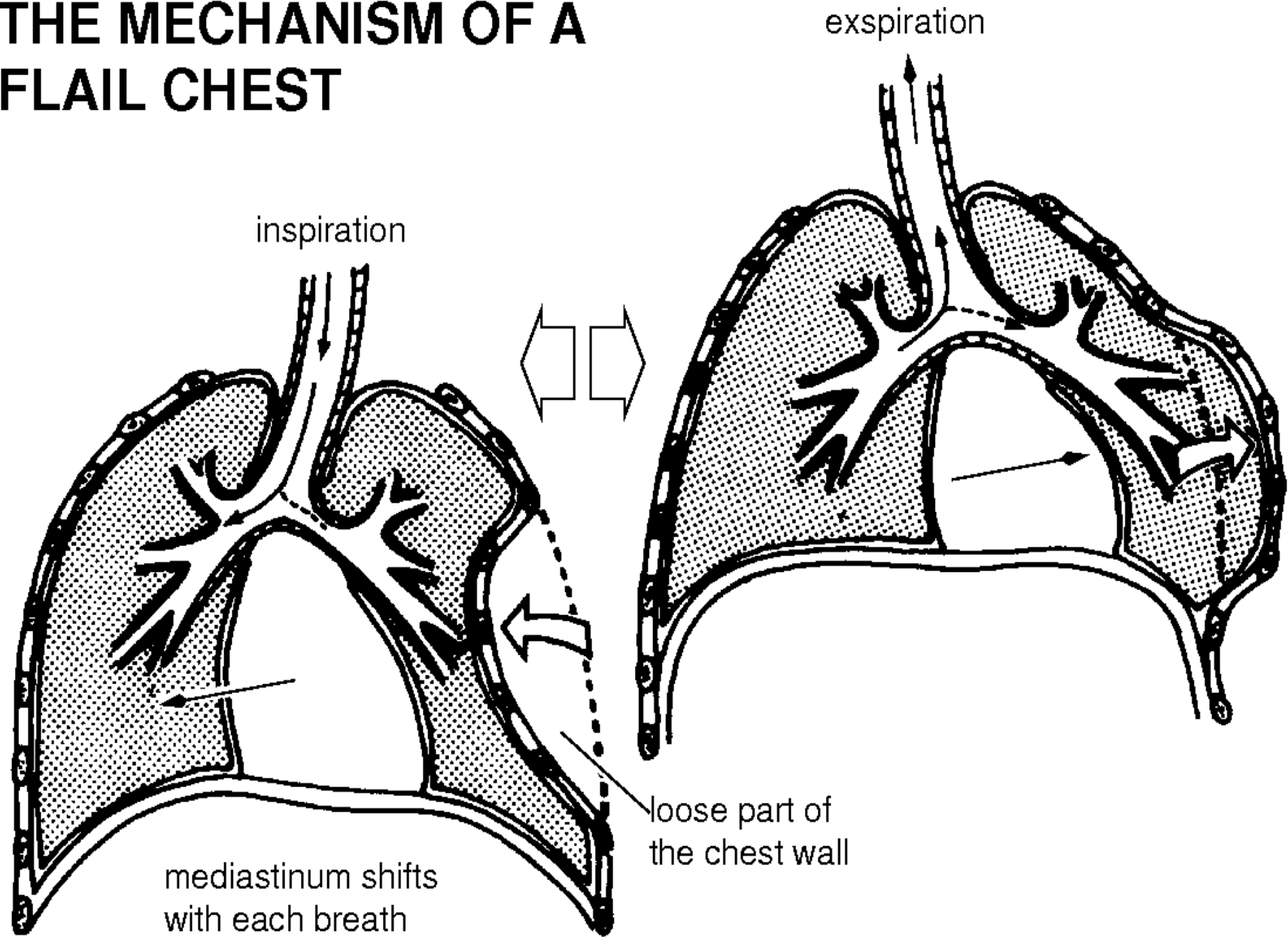


# Flail Chest

- 2 + 2 rule
- Causes
- Signs/Symptoms
- Management
  - Sandbags?
  - Intubation
  - PEEP/CPAP

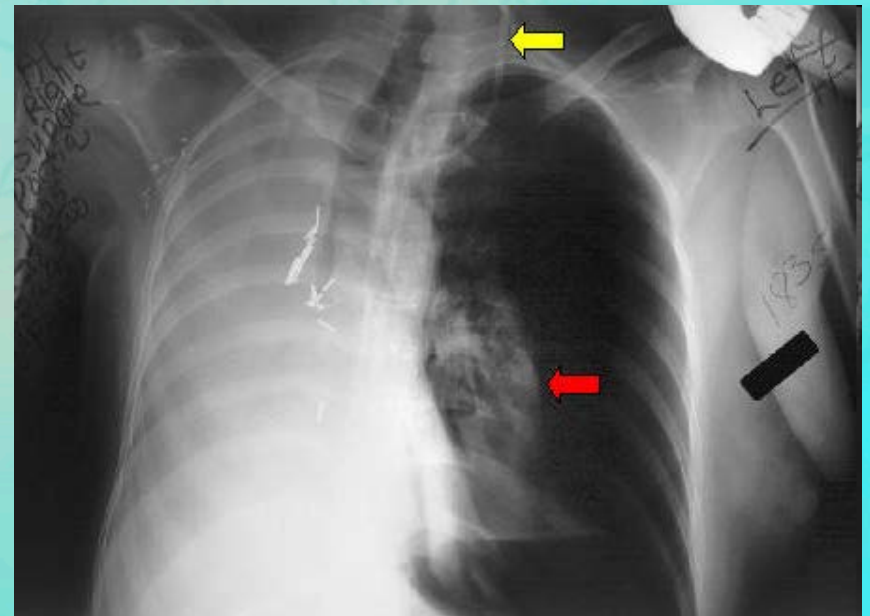
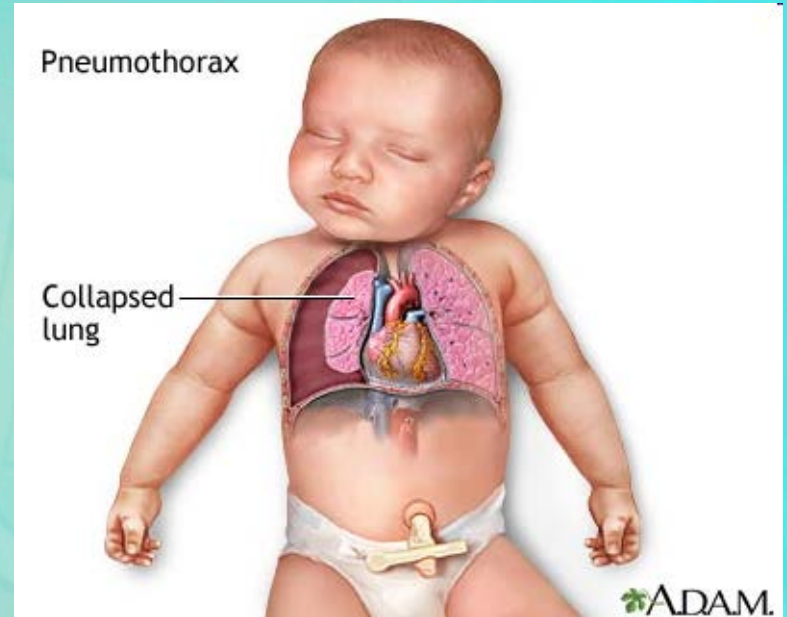


# THE MECHANISM OF A FLAIL CHEST



# Pneumothorax

- Simple
- Open
- Tension
  
- Hemothorax
- Hemopneumo  
Thorax



# Treatment

Simple – Support & Observation

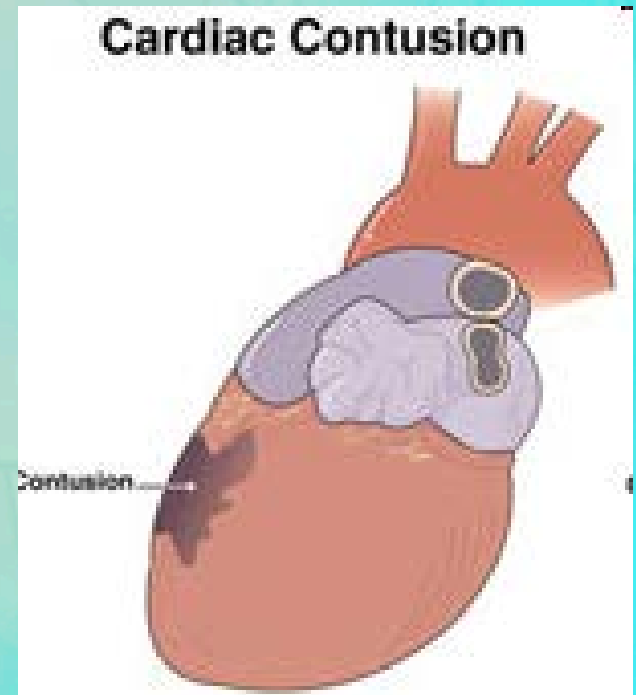
Open – Occlusive dressing

Tension – Pleural Decompression



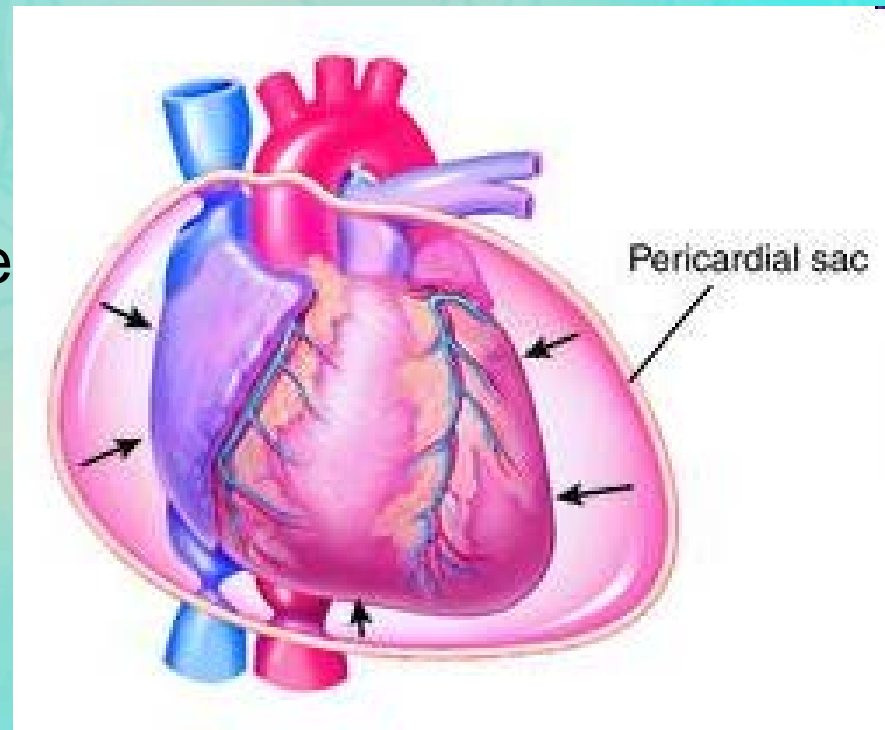
# Cardiac or Pulmonary Contusion

- History – Present and Past
- Mechanism of Injury
- Treat as you would cardiac or respiratory emergency



# Cardiac Tamponade

- Not easily diagnosed in field
- Repeat vital signs are very important
- Beck's Triad
  - JVD
  - Narrow pulse pressure
  - Muffled heart sounds





“ If dead or nearly dead from chest trauma, only two things can be treated in 30 seconds or less”

Tension Pneumothorax

Cardiac Tamponade



# Abdominal Trauma

- Injury to organs
  - Hollow
  - Solid
    - Liver
    - Spleen

The abdomen is the most common site of initially unrecognized fatal injury in traumatized children.

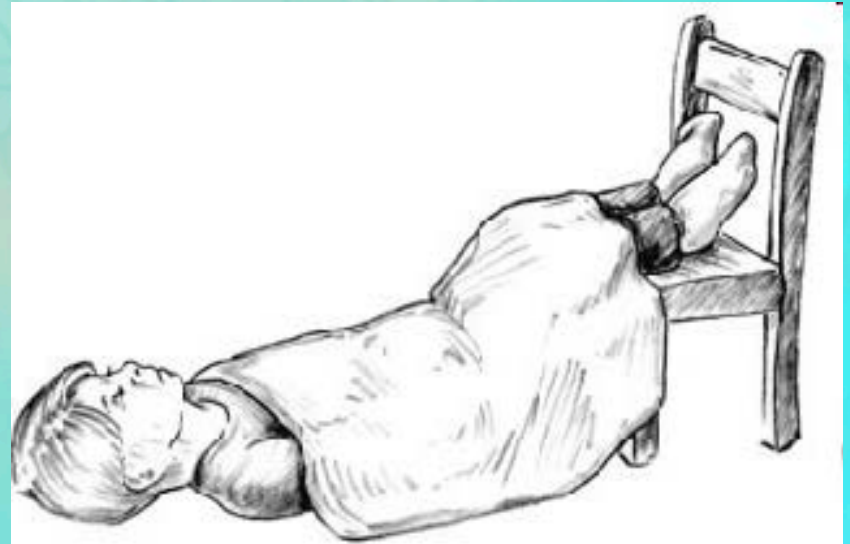


# Seat Belt



# Shock

- Definitions
- Two kinds of bleeding
- Low blood pressure may not be bad
- Plug hole / Fill tank / Shrink tank



# Who remembers these?

- Stabilize fracture (pelvis)
- “Hold Humpty Dumpty Together”
- Does not effectively “auto-transfuse” blood

So... how do we manage an unstable pelvis or pelvic fracture??





# Burns

- Mechanism of Injury
- Location
- Degree
- BSA
- Other trauma
- Inhalation
- Age



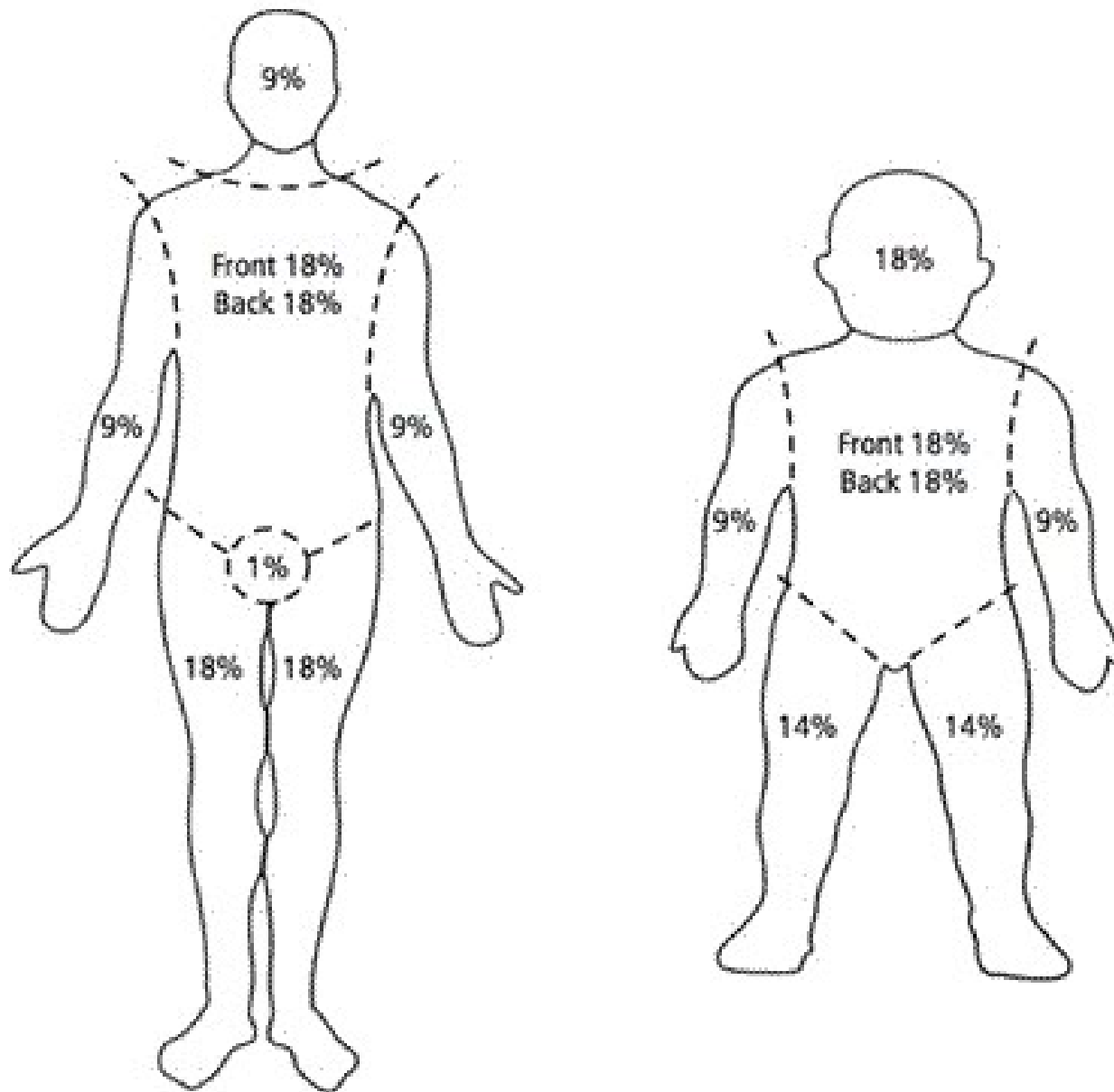
# Burn Treatment

- Stop the burn
  - Cool burn, not patient
- Oxygen / Pulse Oximetry
- Intubate early
- RAD 57
- ECG leads don't stick to burn
- Fluid – Initial Bolus
  - 4cc/kg x BSA
  - 1/2 in first 8 hours









**Figure 2: Adult compared to child burn surface areas**

***TRIAGE***

**START**

**&**

**JumpSTART**



*S.T.A.R.T.* stands for :

- Simple
- Triage
- And
- Rapid
- Treatment



# S.T.A.R.T.

- A system of rapid patient assessment and classification.
- Utilized when patient demand exceeds unit capabilities.



# *Triage*

- Cardinal rule of triage
  - *Do the greatest good for the greatest number!*
- Secondary rule of triage
  - *Saving a life takes precedence over saving of a limb!*



# Triage Categories

## IMMEDIATE

- All patients whose RPM is altered
- Fold & tear off tag
- Retain tracking slip
- Place “Immediate” Label on Victim



# Triage Categories

## DELAYED

- Most victims in this category
- Includes those w/ significant MOI, but whose RPM is intact





# Triage Categories

## MINOR

- These are the “walking wounded.”
- Direct them to a gathering place.
- Tag ‘em later!



# Triage Categories

## DEAD /DYING

- Mortally wounded
- Probably will die despite our efforts
- Difficult decision
- Resources often wasted here



# Just Remember

- **R**<sub>espirations</sub>
- **P**<sub>ulse</sub>
- **M**<sub>ental Status</sub>



# JUMP START

Start for the pediatric patient.



# Why a pediatric triage method?

- START triage system not recommend for patients under 8 years of age.
- To recognize physiological differences between pediatrics patients and adults.
- To minimize the emotional impact of life and death decisions regarding children.



# Jump Start

- For pediatric patients.
- Largely similar to S.T.A.R.T.
- Considers that children can have apnea with a pulse.
- Considers differing normal limits of vital signs.
- Considers unreliability of capillary refill.



# Mobility

- Same principal as S.T.A.R.T.
  - Voice command..”All those that can walk, please go to...”
  - Initially **TAG GREEN**
  - Consider carried infants.
  - Re-triage walking wounded soon.



# Respiratory Considerations

- A child is more likely to have a primary respiratory problem than an adult.
  - If circulation is been maintained, the child may be salvageable.
- The absolute of 30 breaths per minute is inappropriate to determine a child's respiratory status





# Respirations

- No breathing. open airway...
  - breathing .. **TAG RED** .. move on
  - no breathing .. Check carotid pulse ..
    - *No pulse* .. **TAG BLACK** .. move on
    - *Pulse* .. **JUMP START** .. administer 5 ventilations with pocket mask
    - Resumes breathing .. **TAG RED**
    - Still no breathing .. **TAG BLACK**



# Respirations

- Spontaneous breathing .. Assess rate
- $<15$  breaths per min or  $>40$  breaths per min .. **TAG RED** .. move on
- Between 15 and 40 breaths per minute .. Check perfusion



# Circulatory Concerns

- Capillary refill may be unreliable in determining overall circulatory status.
  - Cold environments
- Palpable peripheral pulses are a more reliable sign perfusion status.



# Perfusion

- Assess distal perfusion. check distal pulse..
  - Absent or poor distal pulse ..  
**TAG RED** .. and move on
  - Good distal pulse .. Check mental status ..



# Mental Status concerns

- Utilizing “obeys commands” and “answers questions appropriately” may be inappropriate for all pediatrics patients.
- When indicated, utilizing routine “A-V-P-U” assessment tools will better assess for neurological deficit.



# Mental Status

- Assess utilizing “A-V-P-U” system
  - Is unresponsive or has an inappropriate pain response ..  
**TAG RED** .. move on
  - Is Alert, Verbal or has appropriate pain response .. **TAG YELLOW** .. move on



# Infants

- Patients less than one year old
  - Generally **TAG YELLOW** unless ..
  - Obvious airway compromise, respiratory distress or shock .. **TAG RED**
  - No obvious injury .. **TAG GREEN**



# START/JumpSTART Similarities

- Same R.P.M. Approach
- Once a category has been assigned, further assessment of the patient ceases.
- Ambulatory patients are immediately identified and moved.
- To categorized delayed, a patient must display appropriate respiratory, perfusion and mental status





# START/JumpSTART Differences

- Apneic children are rapidly assessed for continued circulation.
- Apneic children with a central pulse receive a brief ventilatory trial.
- Respiratory rates are adjusted.
- Peripheral pulse is substituted for capillary refill.
- AVPU is utilized to assess mental status.



# Advantages of START/JumpSTART

- Objective triage criteria.
- Minimizes the emotional impact of triage decision making.
- Triage can be performed in a timely fashion/15-30 seconds per patient.
- JumpSTART considers the physiological differences between adults and children.



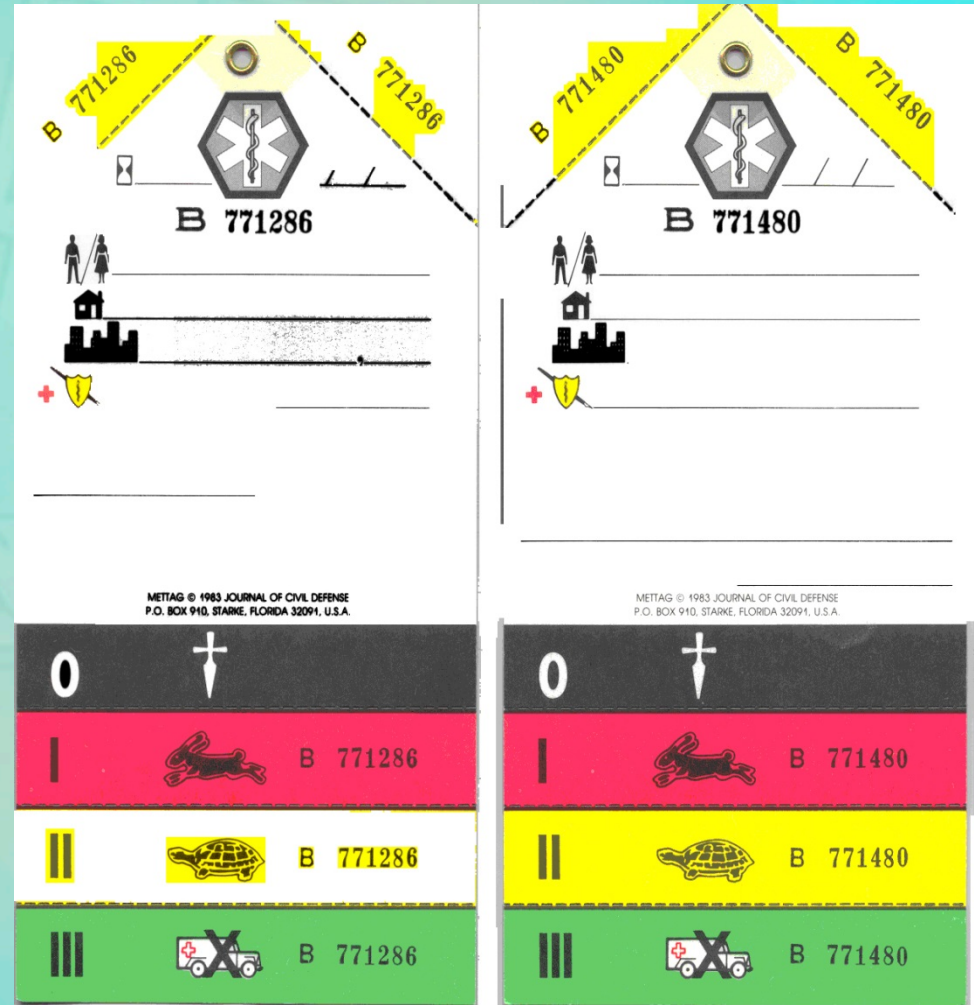
# Disadvantages of JumpSTART

- Extra steps for apneic children add time to the process.
- Mouth to Mask ventilation increases risk of cross contamination of patients.
- Pocket mask must be carried by triage personnel.
- “Too complicated”



# Met-Tag

- Uses four color system
- Individually numbered
- Numbered treatment and transport portions



# Summary

- The START and JumpSTART triage methods present a consistent & objective system of triage.
- The walking wounded are moved away early.
- Each patient is evaluated for improper R-P-M and noted deficiencies categorized RED.



# In closing

- The START Triage method is proven. It works.
- It has been in place in many jurisdictions for some time and has served as a great tool in the worst of times.
- JumpSTART is now being accepted in the system and will no doubt also serve us well in the future.



**"Time and time again the catastrophically injured, who have almost no chance of survival, are provided with heroic resuscitation efforts and are transported by the first crews, leaving little or no personnel and equipment in the field."**

**Dr. Alexander Butman  
Disaster Researcher**

