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Pediatric Trauma: Special Considerations

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Objectives

- Introduction to pediatric trauma in the United States
- Demographics
- Review general approach to trauma (primary and secondary survey)
- Anatomic differences in children
- Differences in physiologic responses to trauma in children
- Differences with injury patterns in children
- Differences in approach

Pediatric Trauma in the United States

- United States has designated pediatric trauma centers, recognition children receive better care
- Trauma center designation given at state or local level, verified by American College of Surgeons (ACS)
- As of 2010, there were 43 pediatric only trauma centers, 12 were ACS (nationally) verified

Missouri Pediatric Level I Trauma Center Criteria

- At least 2 board certified or eligible in pediatric surgeons
- At least 1 board certified or eligible pediatric orthopedic surgeon and one additional board certified or eligible orthopedic surgeon with interests and skills in pediatric trauma care
- At least 1 board certified or eligible pediatric neurosurgeon and one additional board certified or eligible neurosurgeon with interests and skills in pediatric trauma care
- At least 2 physicians who are board certified or eligible in pediatric critical care medicine or in pediatric surgery and surgical critical care.
- At least 2 physicians who are board certified or eligible in pediatric emergency medicine

Missouri Pediatric Level II Trauma Center Criteria

- At least 1 board certified or eligible pediatric surgeon
- At least 1 board certified or eligible orthopedic surgeon with demonstrated interests and skills in pediatric trauma care
- At least 1 board certified or eligible neurosurgeon with demonstrated interests and skills in pediatric trauma care
- Pediatric intensive care unit and the pediatric section of the emergency department must be staffed by individuals credentialed by the hospital to provide pediatric care in their respective areas

Demographics

- In United States:
  - According to the Centers for Disease Control and Prevention (CDC), unintentional injury is the leading cause of death in children and adults from 1 to 44 years
  - *The Global Burden of Disease: 2004 update* by the World Health Organization (WHO) showed 6900 children less than 14 years of age died of unintentional and intentional injuries
- In Ghana:
  - In Africa, trauma is second to infectious disease as the leading killer
  - According to WHO 2004 data, 4100 children less than 14 years of age died of unintentional and intentional injuries

Demographics

- Of the unintentional injuries, motor vehicle-related injuries were the most common mechanism in both countries
- In 2010, the number of road traffic deaths per 100000 population was 11.4 in the United States and 22.2 in Ghana (Global Health Observatory Data Repository)

Overall Approach

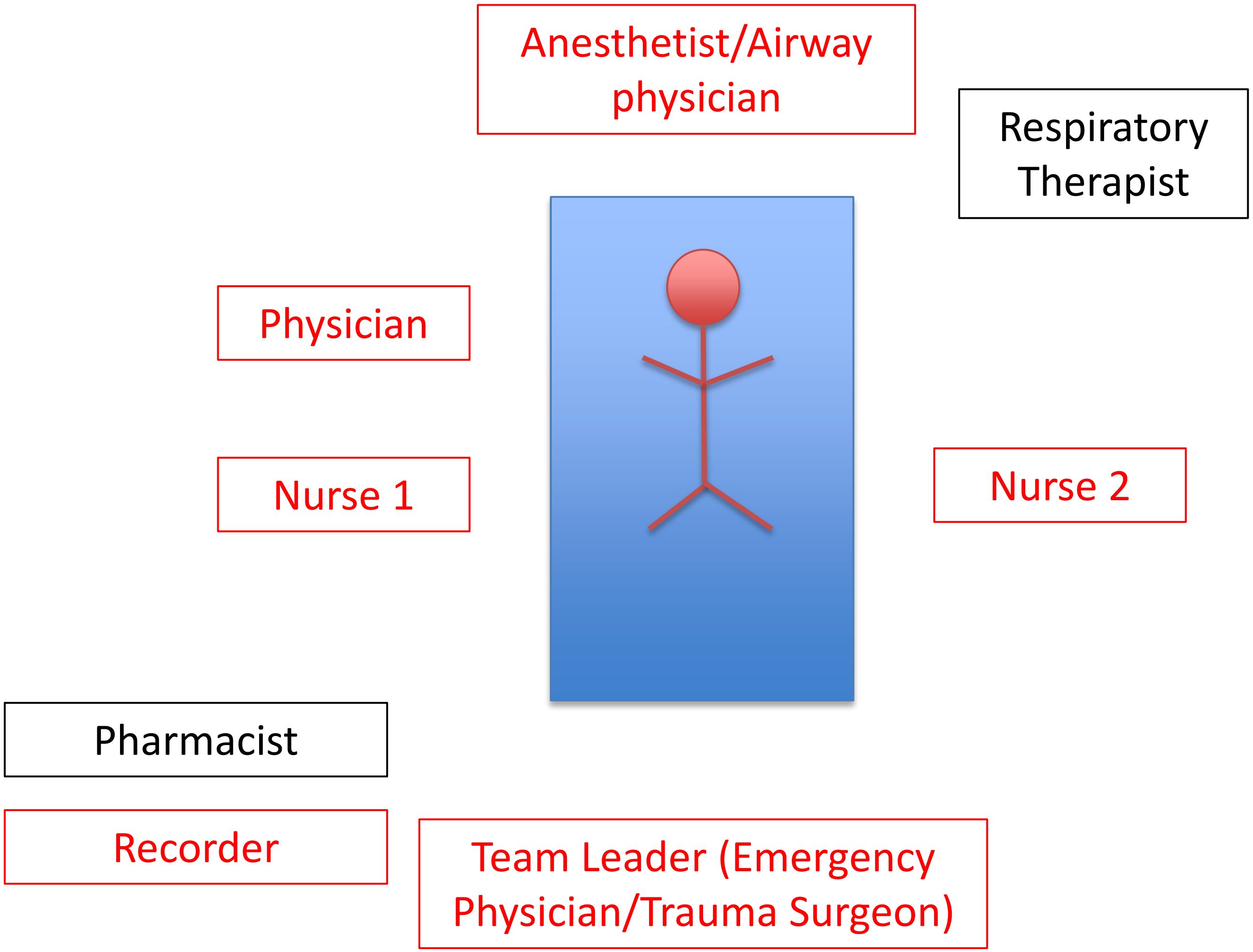
PD-GOV United States Navy, [Wikimedia Commons]

- Tendency to panic when the injured is a child
- “Children are small adults” - Should be organized and prepared whether adult or child
- Goal is to prevent death that occurs minutes to hours after injury (“Golden Hour”)
- Advanced Trauma Life Support (ATLS) is systematic in order to address life-threatening issues first and prevent injuries from being missed

Trauma Bay at St. Louis Children's Hospital

 Ruth S. Hwu, Washington University in St. Louis

General Room Organization



Primary Survey

- Airway maintenance with cervical spine protection
- Breathing and ventilation
- Circulation with hemorrhage control
- Disability: neurologic status
- Exposure/Environmental control: completely undress the patient but prevent hypothermia
- Repeat with deterioration at any point

Advanced Trauma Life Support Student Course Manual, 8th ed, 2008

Secondary Survey

- History (AMPLE)
  - A: Allergies
  - M: Medications currently Used
  - P: Past illnesses/pregnancy
  - L: Last meal
  - E: Events/environment related to the injury
- Head-to-toe evaluation of the trauma patient
- Remove them from backboard as quickly as possible to decrease pressure ulcers and back pain
  - Patients put on backboard by Emergency Medical Services to help with transport
- Images and lab studies
- Transition to definitive care

While the general approach is the same, specific issues arise when dealing with children

Pediatric Trauma: Mechanism

- Motor vehicle-associated injuries most common cause of death from injury in children of all ages
- In the United States, falls are most common cause of injury but usually does not result in death
- Blunt mechanisms account for 90% of injuries in children
- Mechanism and physiologic characteristics lead to multisystem injury

Pediatric Trauma: Anatomy and Physiology

- Skeleton more pliable, so often have internal organ damage without bony fracture
  - Skull or rib fractures suggest high amount of energy
- Mostly blunt trauma that involves the brain due to a larger head
  - With brain injury, hypoventilation and hypoxia is more likely to be an issue than hypovolemia with hypotension
  - Need aggressive airway management

Pediatric Trauma: Anatomy and Physiology

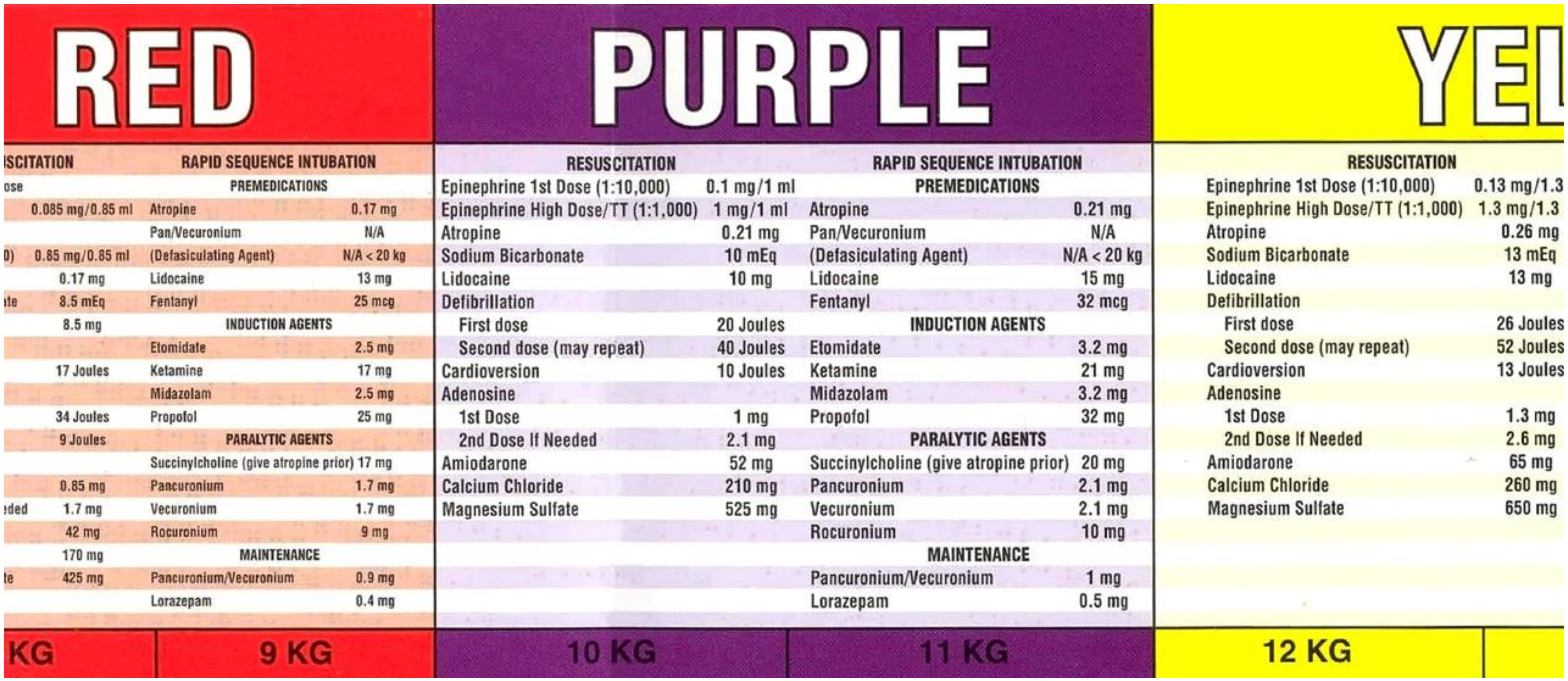
- Due to smaller body mass, more intense injury is transmitted per unit of body area
  - Less fat, less connective tissue, and closer proximity of multiple organs
  - High frequency of multiple injuries
- Higher ratio of body surface area to body volume increases risk of hypothermia

Equipment and Doses Based on Age and Size

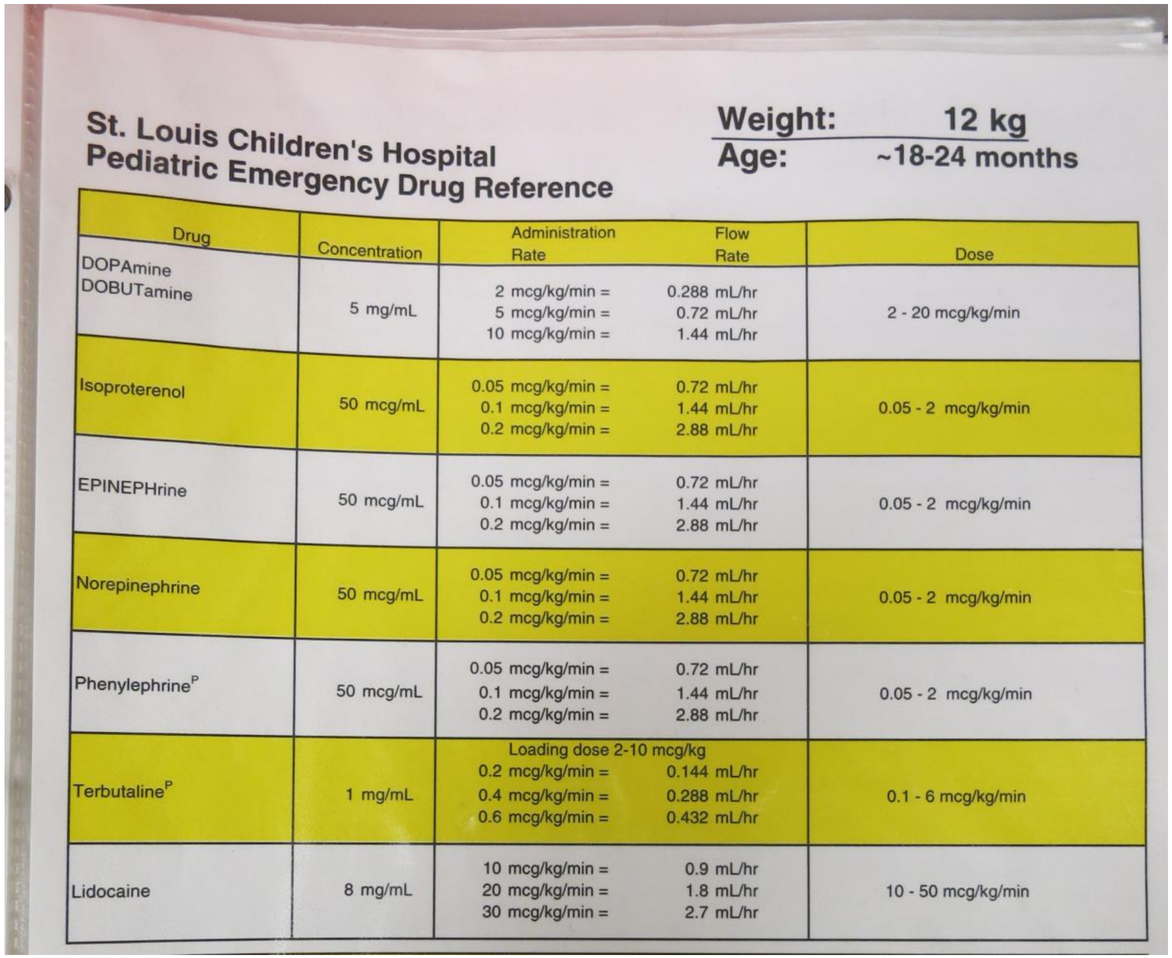
- Broselow Pediatric Emergency Tape to help rapid determination of weight based on length
  - Provides appropriate fluid volumes, drug doses, and equipment size
- Resuscitation/Code book with estimated weights based on age

Broselow Tape

Broselow Tape



Age-Based Code Sheets



St. Louis Children's Hospital
Pediatric Emergency Drug Reference

Weight: 12 kg
Age: ~18-24 months

Drug	Concentration	Administration Rate	Flow Rate	Dose
DOPAmine DOBUTamine	5 mg/mL	2 mcg/kg/min = 5 mcg/kg/min = 10 mcg/kg/min =	0.288 mL/hr 0.72 mL/hr 1.44 mL/hr	2 - 20 mcg/kg/min
Isoproterenol	50 mcg/mL	0.05 mcg/kg/min = 0.1 mcg/kg/min = 0.2 mcg/kg/min =	0.72 mL/hr 1.44 mL/hr 2.88 mL/hr	0.05 - 2 mcg/kg/min
EPINEPHrine	50 mcg/mL	0.05 mcg/kg/min = 0.1 mcg/kg/min = 0.2 mcg/kg/min =	0.72 mL/hr 1.44 mL/hr 2.88 mL/hr	0.05 - 2 mcg/kg/min
Norepinephrine	50 mcg/mL	0.05 mcg/kg/min = 0.1 mcg/kg/min = 0.2 mcg/kg/min =	0.72 mL/hr 1.44 mL/hr 2.88 mL/hr	0.05 - 2 mcg/kg/min
Phenylephrine[P]	50 mcg/mL	0.05 mcg/kg/min = 0.1 mcg/kg/min = 0.2 mcg/kg/min =	0.72 mL/hr 1.44 mL/hr 2.88 mL/hr	0.05 - 2 mcg/kg/min
Terbutaline[P]	1 mg/mL	Loading dose 2-10 mcg/kg 0.2 mcg/kg/min = 0.4 mcg/kg/min = 0.6 mcg/kg/min =	 0.144 mL/hr 0.288 mL/hr 0.432 mL/hr	0.1 - 6 mcg/kg/min
Lidocaine	8 mg/mL	10 mcg/kg/min = 20 mcg/kg/min = 30 mcg/kg/min =	0.9 mL/hr 1.8 mL/hr 2.7 mL/hr	10 - 50 mcg/kg/min

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Size-Dependent Equipment

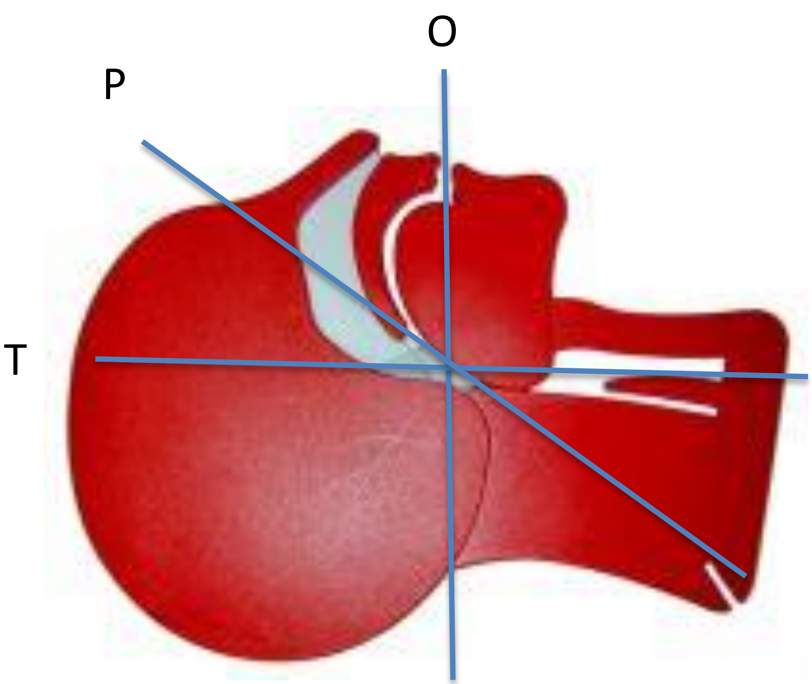
- Oxygen mask
- Oral airway
- Bag mask (pediatric size)
- Laryngoscope
- Endotracheal tube
- Blood pressure cuff
- IV catheter
- Orogastric or nasogastric tube
- Chest tube
- Foley
- Cervical collar

Airway

- Lack of oxygenation and ventilation in a child with an obstructed airway is the most common cause of cardiac arrest in children
- Child's airway can obstruct easily
  - Younger children (< 3 yo) have a larger cranium and occiput, so natural flexion of cervical spine causes pharynx to buckle and obstruct

Airway

Goal to align oral (0), pharyngeal (P), and tracheal (T) axes for intubation, use sniffing position



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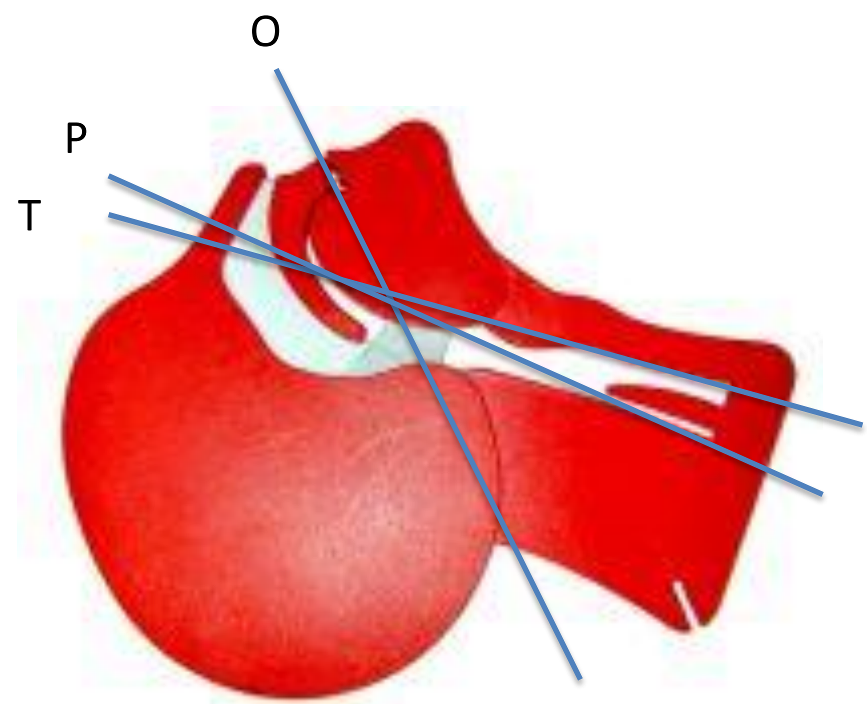

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Airway

Larger occiput in children can cause passive flexion, so put 1 inch thick padding under infant or toddler's entire torso vs. under the head in adults

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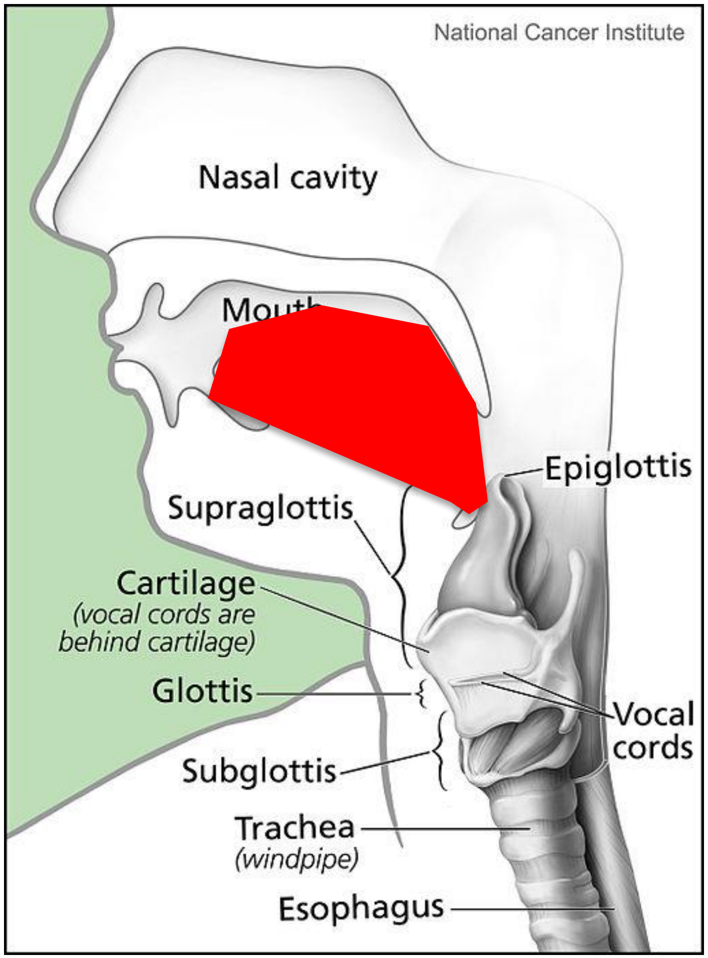
Pediatric vs. Adult Airway

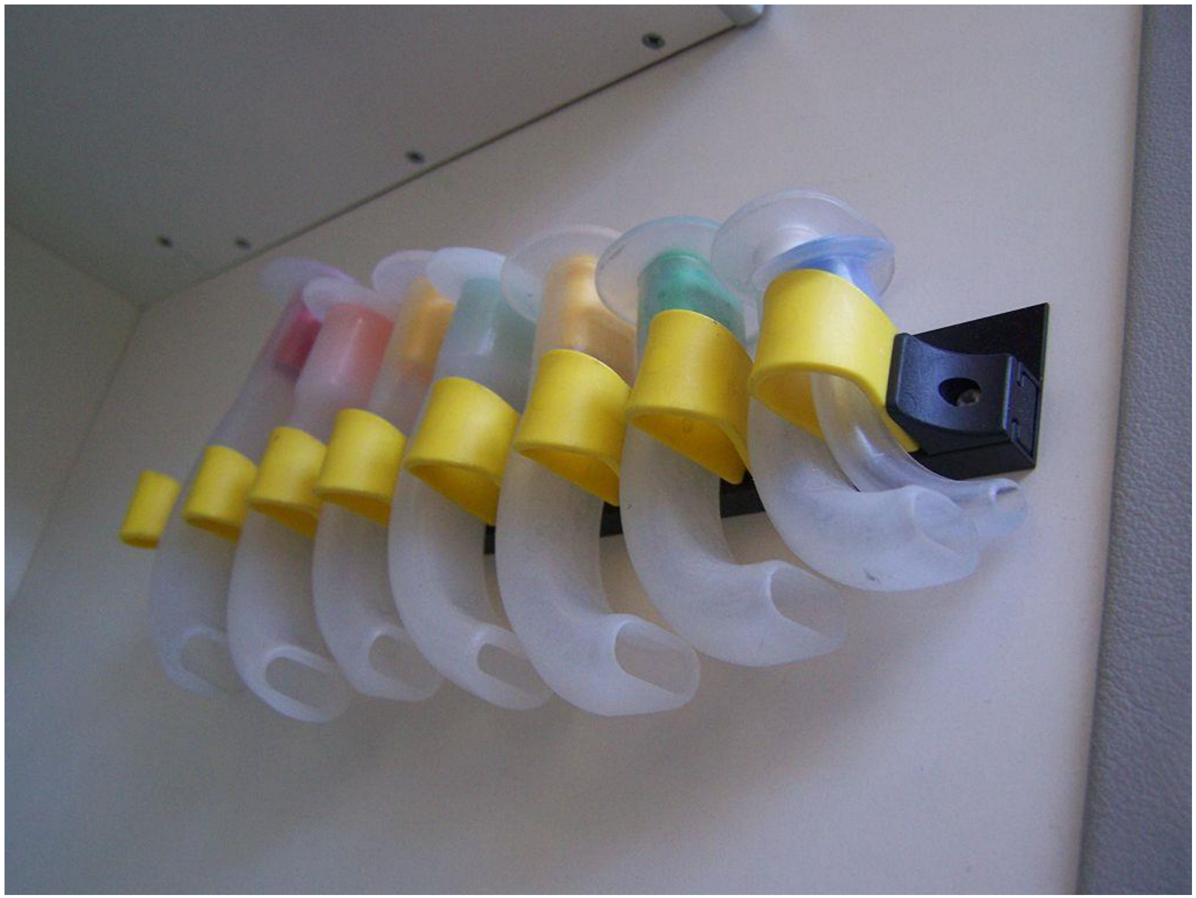


PD-GOV

National Cancer Institute, [Wikimedia Commons]

- Small oral cavity with relatively large tongue and tonsils
- Predisposed to airway obstruction
- Makes visualization difficult
- If child is unconscious, can insert an oral airway to help hold back the tissue

Oropharyngeal Airway



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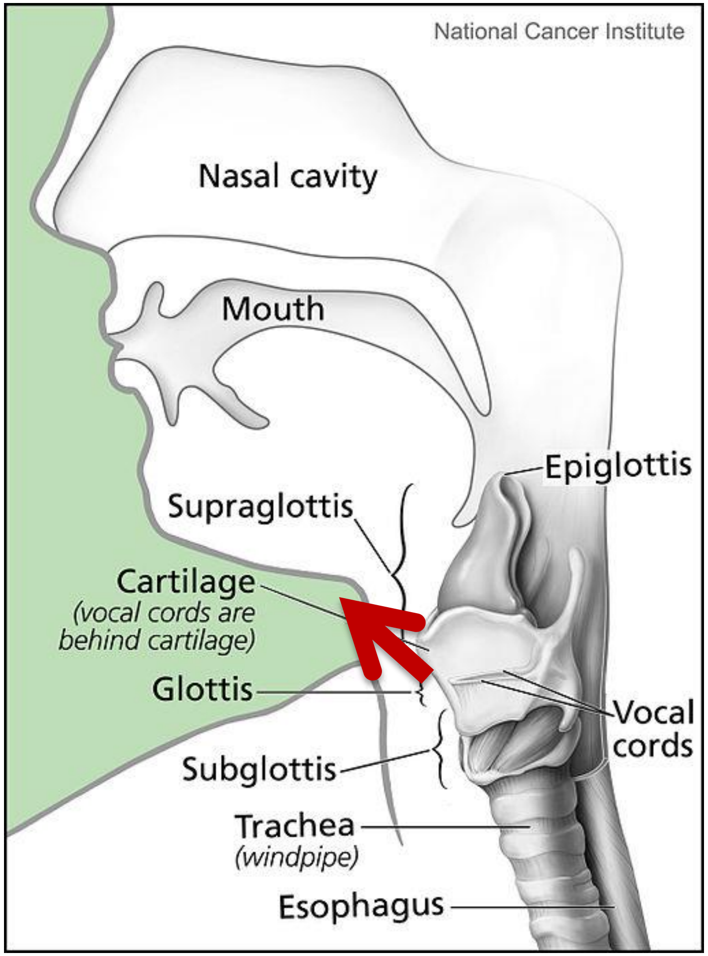
Pediatric vs. Adult Airway

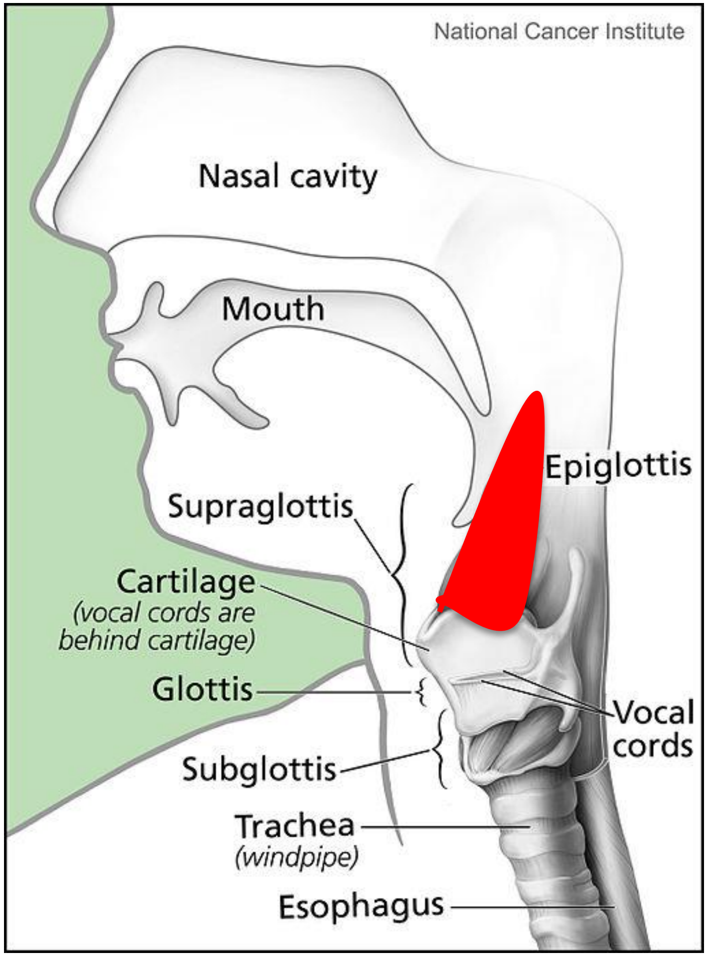


PD-GOV

National Cancer Institute, [Wikimedia Commons]

- Larynx more superior and anterior so more difficult to visualize
- May need to apply posterior-inferior cricoid pressure to help visualize

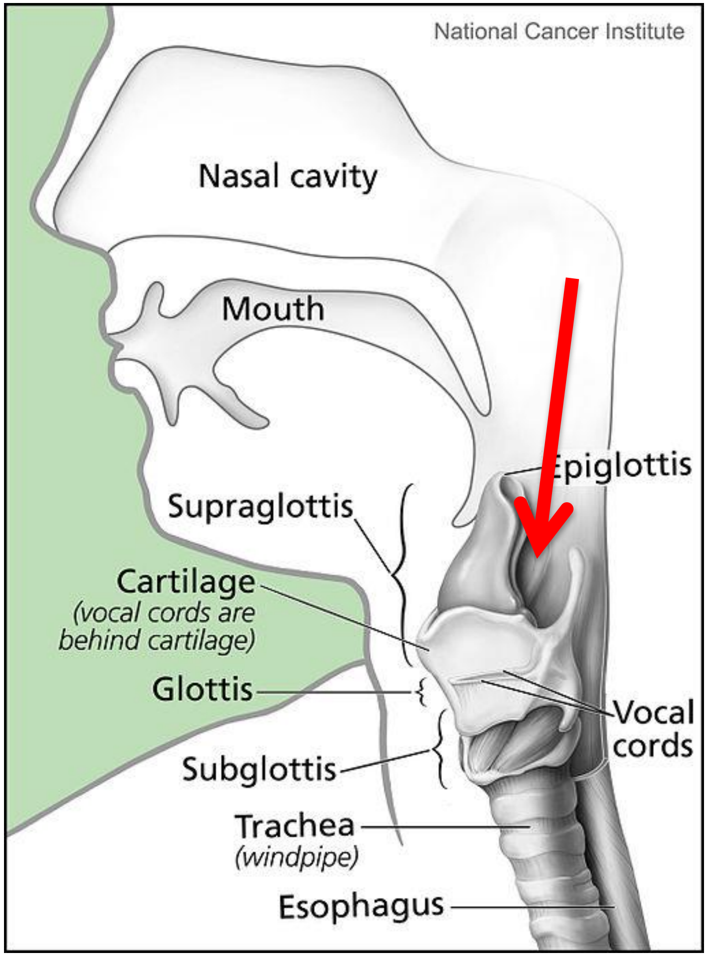
Pediatric vs. Adult Airway



National Cancer Institute, [Wikimedia Commons]

- Floppy and larger epiglottis
- Often, the Miller (straight) rather than the Macintosh (curved) blade is better for intubation

Miller Blade

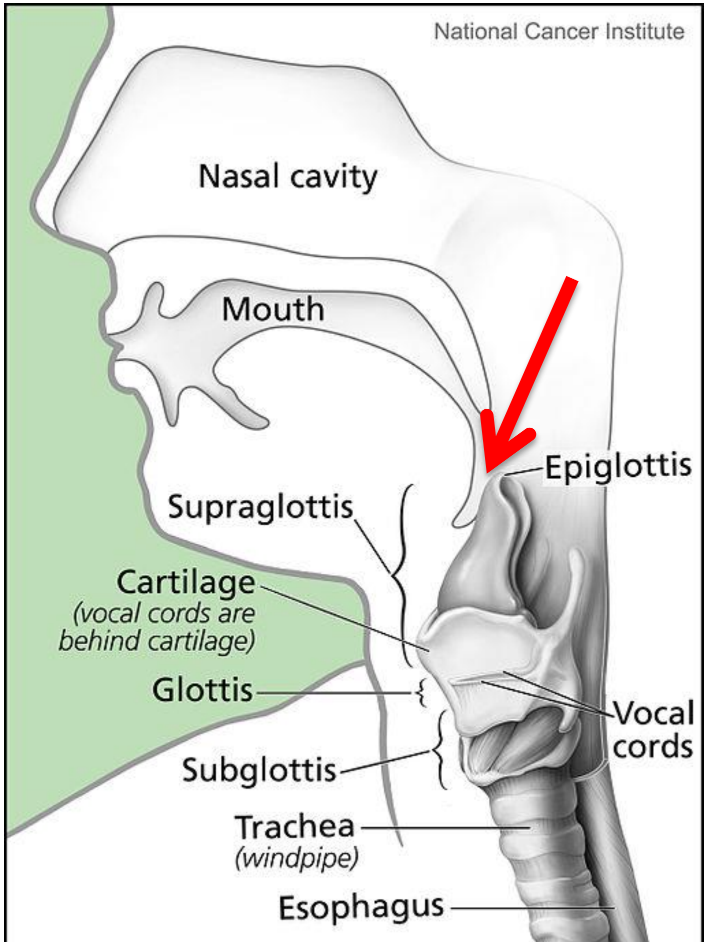


National Cancer Institute, [Wikimedia Commons]

Insert posterior to epiglottis to keep it out of the way

DiverDave, [Wikimedia Commons]

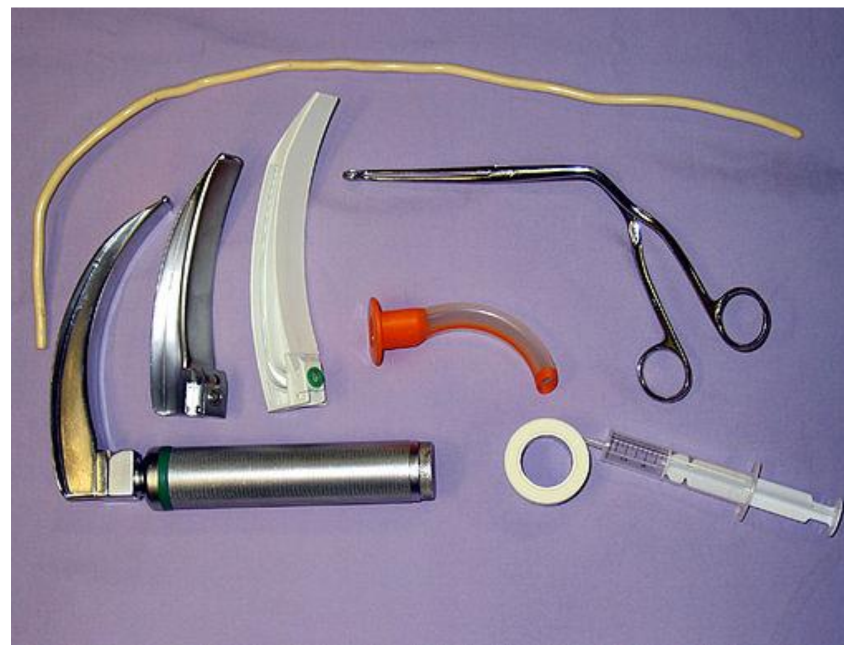
Macintosh Blade



PD-GOV

National Cancer Institute, [Wikimedia Commons]

Insert in vallecula, anterior to epiglottis



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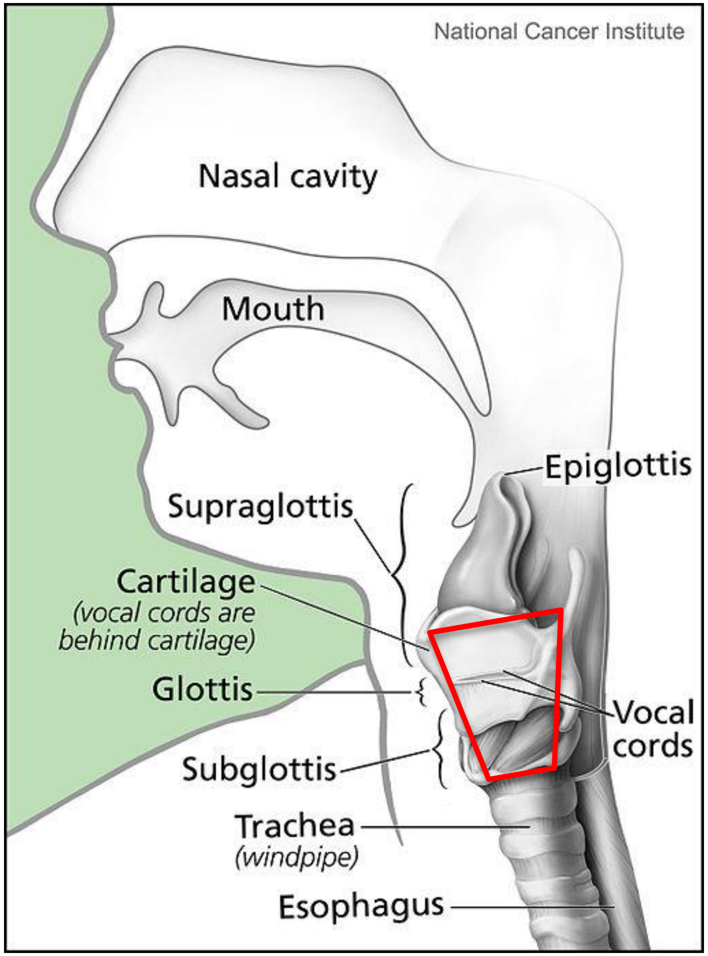
Pediatric vs. Adult Airway



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- Narrowest at cricoid rather than vocal cords
- Tube may be small enough to pass through cords but not cricoid
- Used to recommend uncuffed tube, but now cuffed more common for better ventilation
- Larynx is funnel-shaped, so secretions accumulate in retropharyngeal space

Orotrachal Intubation Indications

- Airway trauma
- Inhalation injury (burns)
- Prolonged seizures
- Severe head injury (GCS $\leq$ 8)
- Significant hypovolemia that leads to depressed sensorium
- Other signs of ventilatory failure

Case 1

A 4 year-old boy is brought in by parents after being hit by a car. He is unresponsive and only taking shallow breaths, so you decide to intubate him. What size tube do you want?

A. 4.5 cuffed ETT
B. 6.0 uncuffed ETT
C. 3.5 cuffed ETT
D. 4.0 uncuffed ETT

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D. 4.0 uncuffed ETT

Intubation Equipment

- Prepare all equipment as in adults
  - Oxygen, suction, IV access, tube, laryngoscope blade, etc.
  - Back-up plan if unable to intubate
- Endotracheal tube size
  - Approximately the diameter of child's external nares or tip of the small finger
  - If ≥ 2 yo, $4+(\text{age in years}/4)$, decrease by 0.5 if cuffed
- Depth of tube
  - 3 x tube diameter size
  - If ≥ 2 yo, $(\text{age in years}/2)+12$ cm

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  - If ≥ 2 yo, (age in years/2)+12 cm

Endotracheal Tube Size < 2 yo

Weight or Age	Tube Size	Depth
Newborn:		
< 1 kg	2.5	6 + weight in kg
1-2 kg	3.0	“
2-3kg	3.5	“
> 3 kg	3.5 – 4.0	“
< 6 months	3.5 – 4.0	10 cm
6 months – 1yo	4.0 – 4.5	11 cm
1 yo – 2 yo	4.5 – 5.0	12 cm

Laryngoscope Sizes

Age	Blade Type and Size
Newborn	Miller 0
1 – 12 months	Miller 1 or Wis 1.5
12 – 3 years	Wis 1.5 or Miller 2
3 – 12 years	Miller 2 or Macintosh 2
12 – 16 years	Miller 2 or Macintosh 3
> 16 years	Miller 3 or Macintosh 4

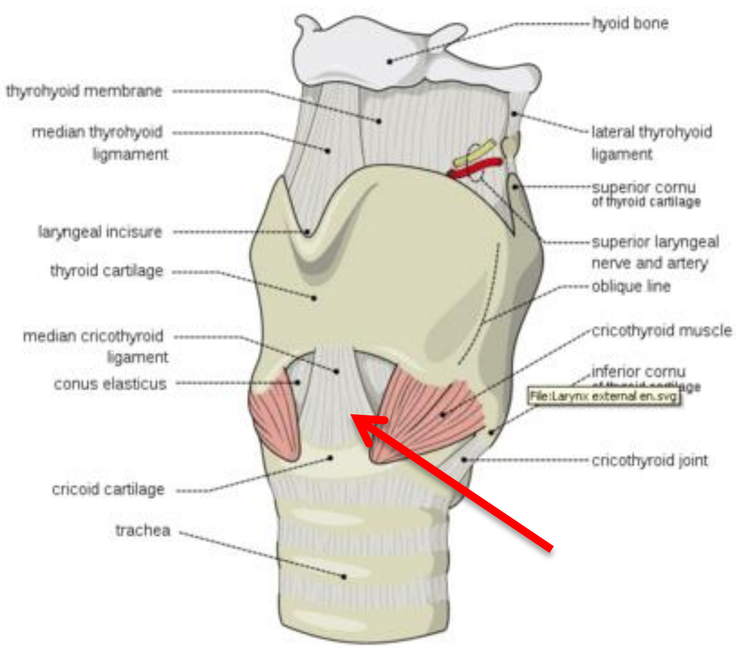
Intubation

- Preoxygenation
- Premedication: atropine 0.02 mg/kg (max 0.5mg) if less than 1 year old to prevent bradycardia
  - Lidocaine is no longer indicated in emergent setting
- Sedation:
  - Etomidate 0.2-0.4 mg/kg IV
  - Ketamine 2 mg/kg
- Paralysis:
  - Succinylcholine 2 mg/kg if < 1 yo and 1 mg/kg if ≥ 1 yo
  - Vecuronium 0.1 mg/kg
- Take cervical collar off and hold inline immobilization

Intubation

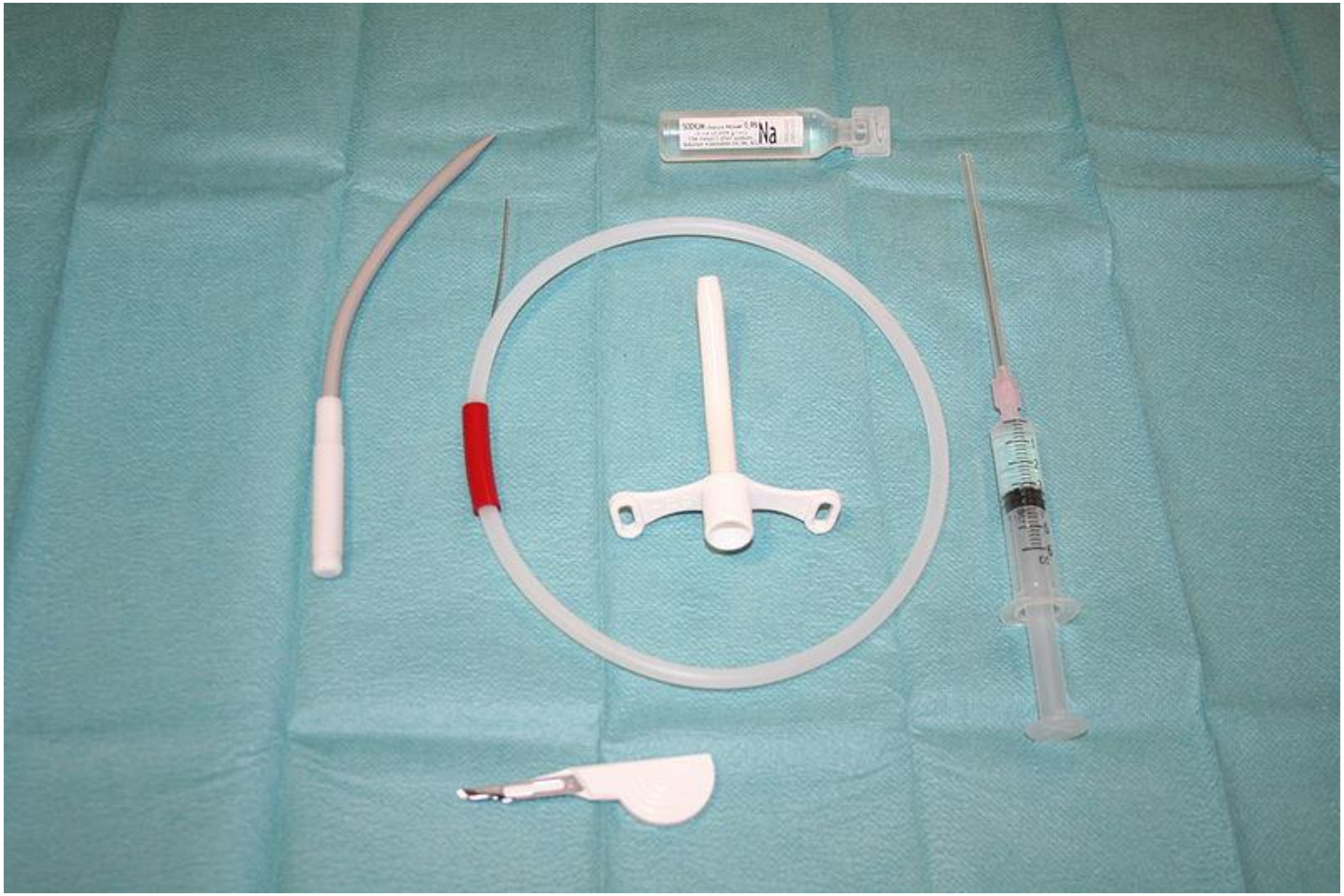
- Endotracheal tube should be positioned 2-3 cm below level of vocal cords
- Check for tube position
  - Bilateral breath sounds
  - Capnography or colorimetric device
  - Chest x-ray
- Trachea is about 5 cm long in infants and 7 cm in toddlers
  - Right mainstem intubation is common
  - Small movements may dislodge the tube

Cricothyroidotomy



- More difficult to feel in younger children due to softer cartilage
  - Surgical cricothyroidotomy rarely indicated for infants
- Could use needle cricothyroidomy using 16 or 18 gauge angiocath and attach 3.0 or 3.5 ETT cap to end
  - Allows for oxygenation but not ventilation

Cridothyroidotmy Kit



Svenriviere, Wikimedia Commons

Breathing

- Be familiar with normal respiratory rate based on ages to be able to assess adequate ventilation
  - Infants typically breathe 30 to 40 times per minute
  - Older child typically breathe 15 to 20 times per minute
- If available, use bag-mask devices designed for children
  - Typical tidal volume for child is 4 to 6 ml/kg
  - Immature tracheobronchial tree and alveoli increases risk of barotrauma, especially with adult devices
  - Goal is gentle chest rise

Pneumothorax

- Similar in children and adults
  - Needle decompression over top of 3rd rib in mid-clavicular line
  - Chest tube insertion 5th intercostal space
- Be careful with needle decompression because due to thinner chest wall, the needle itself can cause a tension pneumothorax
- When inserting chest tube, more important to start initial incision site near bottom of rib and tunnel over rib for better seal

Circulation

- Multisystem injuries in children may lead to significant blood loss
- Children have higher physiologic reserve and can maintain systolic blood pressure while in hypovolemic shock (compensated)
- Tachycardia is usually the first sign of shock, and blood pressure may be maintained with a blood loss of up to 45%
    - Know normal vital signs

Normal Heart Rate for Age

Age	Awake Rate (beats/min)	Sleeping Rate (beats/min)
Newborn – 3 months	84 to 205	80 to 160
3 months – 2 years	100 to 190	75 to 160
2 – 10 years	60 to 140	60 to 90
> 10 years	60 to 100	50 to 90

PALS 2010

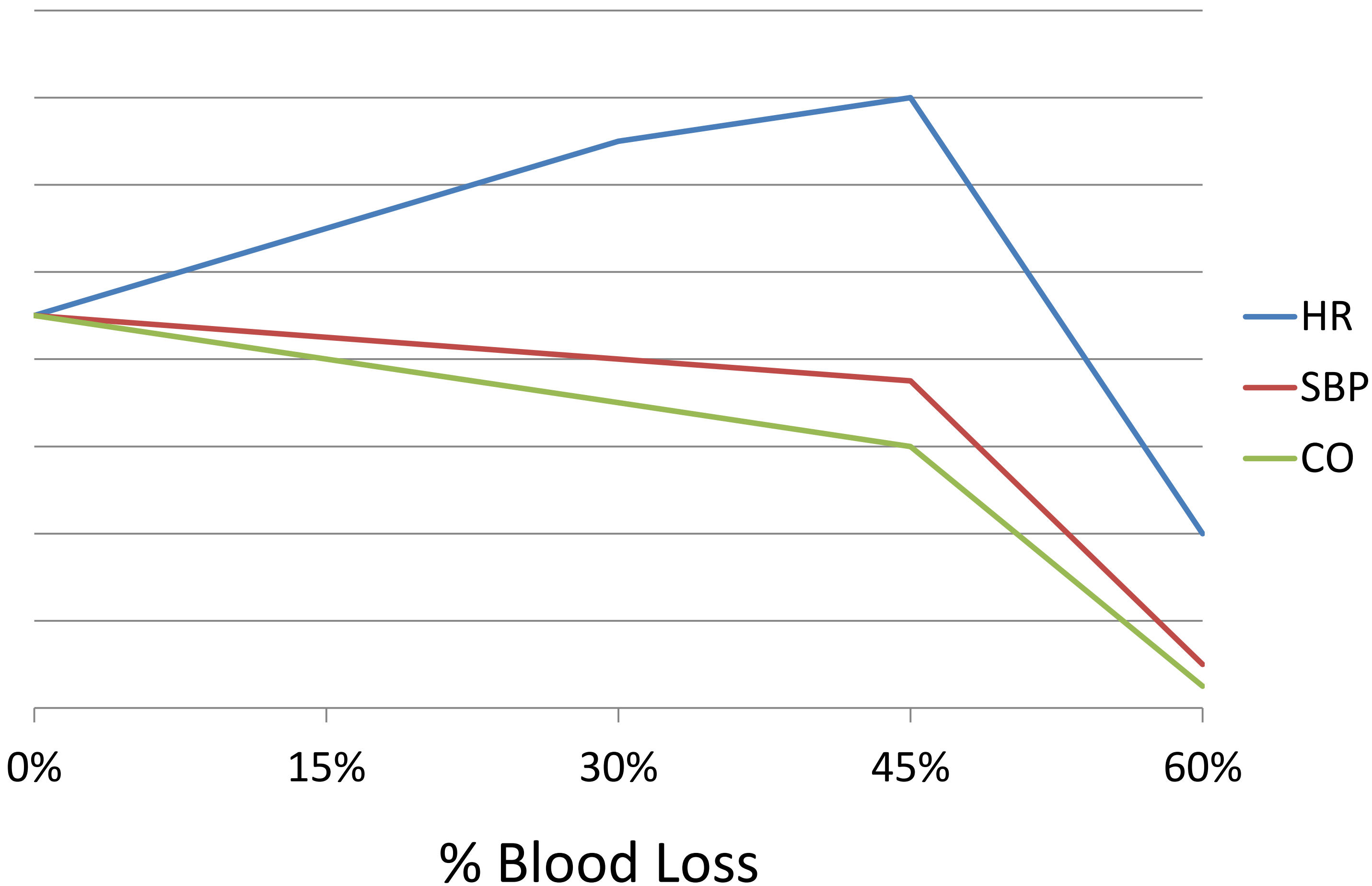
Early Signs of Hypovolemic Shock

- Tachycardia
- Poor skin perfusion
  - Delayed capillary refill
  - Mottling
- Weak peripheral pulse
- Narrowing of pulse pressure to 20 mmHg

Hypovolemic Shock

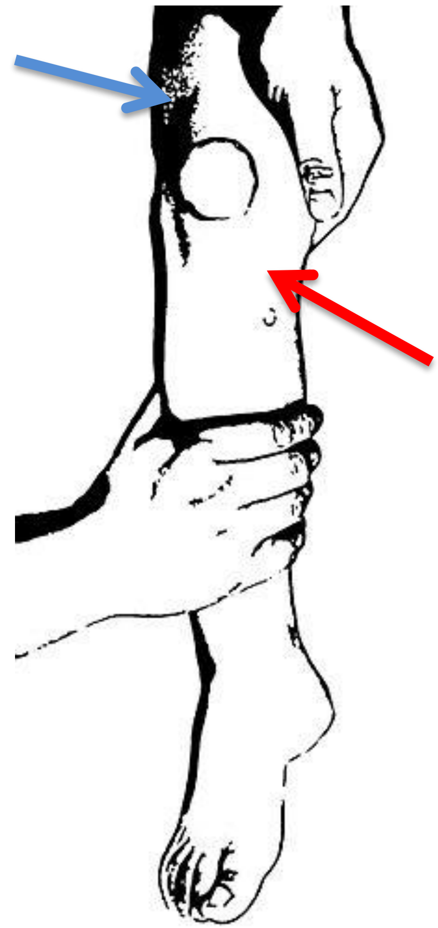
- Lower limit of normal systolic blood pressure (SBP) in children is 70 mmHg + 2 x age in years
- Diastolic blood pressure (DBP) is about two thirds of SBP
- Hypotension is a sign of decompensated shock
- With hypotension, tachycardia can change to bradycardia suddenly in infants

Hemodynamic Changes from Hypovolemia in Children



Management of Hypovolemic Shock

- Preferably obtain peripheral percutaneous access
- Use an intraosseous needle for infusion if unsuccessful after 2 attempts, be conscious of the depth
  - Anteromedial tibia or distal femur, NOT around fracture site



Trish Rubke, Wikimedia Commons

Fluid and Blood Resuscitation

- Children have blood volumes based on size
  - Infant blood volume typically 80 ml/kg
  - Child's blood volume typically 70 ml/kg
- Give 20 ml/kg normal saline bolus rapidly
  - Current teaching is to give 3, replaces about 25% of lost intravascular volume, then start O neg PRBCs
  - Adult studies have shown sooner use of blood products may improve survival
- With massive hemorrhage, should give blood products in balanced manner of red blood cells, plasma, and platelets to limit coagulopathy

Response to Resuscitation

- Look for:
  - Slowing of the heart rate and improved SBP
  - Improvement of mental status
  - Return of peripheral pulses
  - Normal skin color
  - Warmth of extremities
  - Urine output (1-2 ml/kg/hr)
- As in adults, if only responding transiently or is not responding to crystalloid and blood, consider early operation

Cardiac Arrest

- A systematic review showed an overall mortality of 96.7% for adults vs. 86.4% for children who received CPR in the pre-hospital setting and had return of spontaneous circulation (ROSC) prior to arrival to hospital (Zwingmann *et al.* *Critical Care* 2012)
- Children receiving CPR for more than 15 minutes prior to arrival to the emergency department or have fixed pupils are unlikely to survive

Disability

- Children may be more difficult to assess depending on developmental level
- For infants, observe movement of extremities and response
- Fussiness may be an indicator of poor cerebral perfusion or head injury or just anxiety

Glasgow Coma Scale

	Adult/Child	Infant	Score
Eye Opening	Same	Same	
Best Verbal	Oriented, appropriate	Coos and babbles	5
Response	Confused	Irritable cries	4
	Inappropriate words	Cries to pain	3
	Incomprehensible sounds	Moans to pain	2
	No response	No response	1
Best Motor	Obeys commands	Moves spontaneously	6
Response	Localizes to pain	Withdraws to touch	5
	Withdraws to pain	Withdraws to pain	4
	Flexion to pain	Flexion to pain	3
	Extension to pain	Extension to pain	2
	No response	No response	1

Exposure/Environmental Control

- Due to high ratio of body surface area to body mass, have increased heat exchange
  - Increased evaporative heat loss with thin skin and less subcutaneous tissue
  - Children with burns particularly susceptible
- Hypothermia can worsen coagulopathy and adversely affect neurologic function
- Use thermal blankets, heaters, warm the room, warm the fluids and blood products

Laboratory Tests and Imaging

- Depends on mechanisms and injuries on exam
- Labs: Full blood count (FBC), serum electrolytes, blood urea nitrogen (BUN), creatinine (Cr), hepatic function panel, lipase, urinanalysis
  - prothrombin time (PT), partial thromboplastin time (PTT), type and screen depending on severity of injury
- Images: chest x-ray, pelvic x-ray, c-spine x-ray
  - CT of head and abdomen/pelvis, maybe chest if appropriate
  - Be wary of radiation: lethal malignancy of 1 in 1000 to 1 in 5000 pediatric head CTs
  - X-rays of extremities

Head Trauma

- In children, mostly from motor vehicle crashes, child abuse, and falls
- In multisystem injury, hypotension and hypoxia can have an adverse effect on the outcome of intracranial injury
  - Hypotension usually from reason other than head injury
- Usually do not lose too much blood itself from head injuries except:
  - Scalp injuries can lead to loss of a large amount of blood
  - Infants may lose a significant amount of blood in the subgaleal, subdural, or intraventricular spaces due to open fontanelle and cranial sutures

Physiologic Differences of the Head

- Brain size doubles in first 6 months of life, and by 2 years of age, brain is 80% of adult size
- Smaller subarachnoid space results in less protection
- With larger head and less protection, head momentum more likely to lead to parenchymal structural damage
- Cerebral blood flow is twice the amount of an adult by 5 years of age, so extremely susceptible to cerebral hypoxia and hypercarbia
- In infants with open sutures and fontanelles, signs of brain swelling may occur late, right before rapid decompensation

Management

- Head CT without contrast depending on history and physical exam
- Increased intracranial pressure from brain swelling develops more commonly in children, so may need neurosurgical consultation for intracranial pressure monitoring
- For increased intracranial pressure, can give hypertonic saline 3% (3 to 5 ml/kg) or mannitol (0.1 to 1.0 g/kg)
  - Mannitol can worsen hypovolemia, so hypertonic saline preferred if patient not hemodynamically stable
- Treat hypoxia and hypoperfusion aggressively (ABCs)

Cervical Spine

- Spinal cord injury uncommon in pediatric group
  - Occurs in less than 1% evaluated for trauma
  - Accounts for about 5% of all spinal cord injuries
- Anatomic differences:
  - Interspinous ligaments and joint capsules more flexible
  - Vertebral bodies wedged anteriorly
  - Large head of child means fulcrum is higher in the cervical spine and higher injuries

C-spine Management

- Start with plain films of c-spine, unless patient unresponsive and head CT will be done, then can obtain C-spine CT
- Normal x-ray and CT does not necessarily rule out spinal cord injury
  – Children may have “spinal cord injury without radiographic abnormalities” (SCIWORA) more commonly than adults
  – May need neurosurgical consultation and MRI

Thoracic Trauma

- 8% of injuries in children involve the chest, mostly due to blunt mechanisms
- 66% - 82% of children with chest injuries have multisystem injuries
- 15 - 26% mortality rate in children with thoracic injuries but usually due to other injuries such as blunt head trauma

Thoracic Trauma: Physiologic Differences

- Less ossified bones in child make the chest wall more compliant
  - More force is transmitted to intrathoracic organs
  - Can have serious intrathoracic trauma without much visible damage to chest wall
- Increased mobility of mediastinum increases the risk of tension physiology from pneumothorax or hemothorax
- Commotio cordis more common in children

Types of Thoracic Injuries

- Posterior displacement or dislocation of clavicle (usually at physis) can be associated with injury to esophagus and great vessels
- Pulmonary contusion seen most commonly in children with blunt trauma (49%)
- Rarely see diaphragmatic rupture, aortic transection, tracheobronchial tears, flail chest, sternal fractures
- Life-threatening injuries are uncommon in children due to fewer penetrating mechanisms

Imaging

- Most chest injuries in children can be seen on chest x-ray
- Chest CT:
  - Not routinely used in children due to lower incidence of cardiac and great vessel injury
  - Obtain if have widened mediastinum or findings on plain film that cannot be explained
- Bedside ultrasound to evaluate for pericardial fluid

Management

- Most chest injuries in children can be managed using supportive care or a chest tube if pneumothorax or hemothorax present
- Indications for emergency department thoracotomy in children similar to adults:
  - Penetrating thoracic trauma that is hemodynamically unstable
  - Signs of cardiac tamponade
  - Thoracic or trauma surgeon available within 45 minutes

Abdominal Trauma

- Abdominal physical exam can be difficult in young children, particularly if crying
- 25% of prepubertal children with multisystem injury have significant abdominal injury
- Smaller anterior-posterior diameter of children and smaller torso gives less area for force to dissipate
- 20% mortality if isolated organ injury
  - Increases to 20% if gastrointestinal tract involved
  - Increases to 50% if major vessels involved

Signs of Abdominal Injury

- Ecchymoses, particularly around umbilicus and flank
- Seatbelt sign
- Abdominal distension (but could be from crying)
- Abdominal tenderness or rigidity
- Pain in left shoulder with palpation of left upper quadrant

Case 2

An 8 year-old boy is brought in after a car accident at 40 miles per hour. He was sitting in the back seat with a shoulder and lap belt. On exam, his vitals are HR 88, RR 24, BP 96/64, 100% on room air. GCS is 15. He has some bruising to his lower abdomen and upper left chest with some mild tenderness. What do you do (after ABCs)

A. Send labs and observe
B. Admit and observe
C. Obtain abdomen/pelvic CT with po contrast
D. Obtain abdomen/pelvic CT with IV contrast

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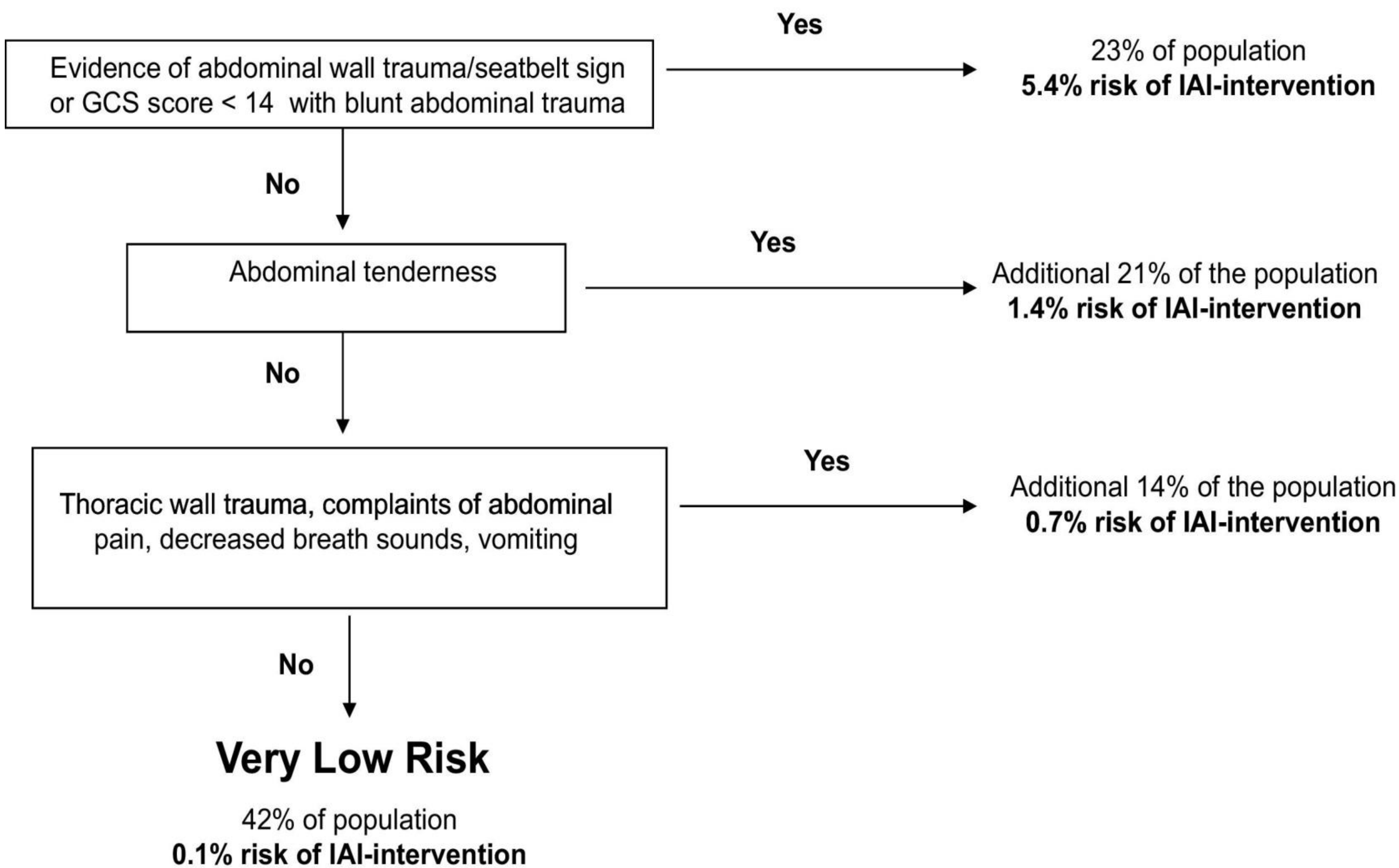
Identifying Children at Very Low Risk of Clinically Important Blunt Abdominal Injuries



 Source: Holmes JF et al. *Ann Emerg Med* 2013; 62:107 - 116.e2

Laboratory Studies

- FBC
- Serum electolytes, BUN, Creatinine
- Hepatic Function Panel
- Lipase
- Urine dipstick (for blood)

Abdominal Injury Management

- Abdominal/pelvic CT with IV contrast vs. observation in stable child
  - CT if exam concerning without waiting for labs
  - Can scan based on labs: AST > 200 U/L or ALT >125 U/L, Hct<30%, gross hematuria, abnormal lipase
  - Want to limit unnecessary radiation exposure
- Children with signs of abdominal injury and hemodynamic instability should be taken for emergent laparotomy

Focused Assessment Sonography in Trauma (FAST)

- Not as effective in the management of children
- Identifies intra-abdominal fluid, but may not need surgical intervention
- Poor study for identifying intra-parenchymal injuries, which account for up to 1/3 of solid organ injuries in children

Extremity Trauma

- Can be difficult to diagnose in children due to presence of growth plate (physis) or lack of mineralization around the epiphysis
  - Growth plates may be mistaken for fractures
  - Fractures in growth plates may be difficult to see
- Different growth plates close at different times
  - Typically growth stops 2 years after pubertal growth spurt completed

Age and X-rays

- Upper humeral physis fuses around 20-22 years
- Distal femoral physis fuses at 14-16 years in girls and 16-18 years in boys
- Proximal fibula epiphysis unites with diaphysis around 17 years
- Proximal tibia physis fuses around 13-15 years in girls and 15-19 years in boys

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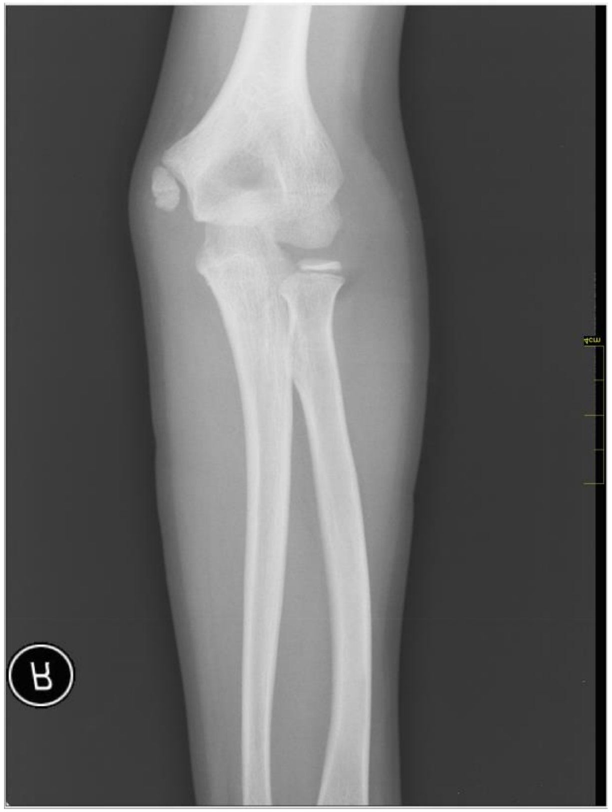
Growth Plates

PD-INEL Source Undetermined



PD-INEL Source Undetermined

The Immature Skeleton

- Injury to or around physis can lead to problems with growth
  - Crush injuries to the growth plate have the worst prognosis
  - Supracondylar fractures at elbow or knee are at high risk for vascular and growth plate injury
- Immature bones are pliable
  - Greenstick fracture: One side of the cortex still intact
  - Torus (or Buckle) fracture

Case 3

A mother brings her 3 month-old, previously healthy son for fussiness and decreased movement of his right leg. Vitals are normal. The only finding on his exam is a swollen right thigh, and he screams whenever you touch it. You get an x-ray, and he has a femur fracture. What do you do next?

A. Splint the right leg and have them follow up in orthopedics clinic in a few days
B. Consult orthopedics
C. Reassure the mother
D. Consult orthopedics and obtain further x-rays and labs

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Non-Accidental Trauma: Special Circumstances

- Non-accidental trauma, or child maltreatment accounts for largest proportion of homicides in children less than 12 months old
- Should always consider particularly when non-verbal children present with injuries

Recognizing Maltreatment

- Understand mechanisms of injury – discrepancy between history and degree of injury or injury pattern
- Delayed seeking of care
- History of repeated trauma, multiple ED visits
- Mechanism implausible for child's developmental age, should know when child is more mobile
  - Rolls at 6 months
  - Sits at 7 months
  - Pulls to stand/cruises around 9 months

Concerning Physical Findings

- Bruises in different stages of healing or of certain patterns, i.e. bruises in shape of hand or belt buckle
- Fractures of different ages on x-ray
- Injuries to genital or perianal area
- Fractures of long bones in children < 3 yo
  - Classic metaphyseal lesions or bucket handle fractures
- Multiple subdural hematomas
- Retinal hemorrhages
- Sharply demarcated 2nd or 3rd degree burns
- Skull or rib fractures in children less than 2 years old
- Intra-abdominal injury without history of trauma

Metaphyseal Fracture

Medical Evaluation for Suspected Non-Accidental Trauma

- < 1 years old
  - Head CT if concerned about head injury, otherwise brain MRI
  - Skeletal survey
  - Opthalmology exam (for retinal hemorrhages)
  - Labs: FBC, serum electrolytes, BUN, serum creatinine, hepatic function panel, lipase, urinanalysis, PT/PTT (if bruising or had head CT)
  - Admit if medical concerns or cannot find safe place to stay

Medical Evaluation for Suspected Non-Accidental Trauma

- 1 to < 2 years old:
  - Head CT if concerned about head injury
  - Skeletal survey
  - Labs: FBC, serum electrolytes, BUN, serum creatinine, hepatic function panel, lipase, urinanalysis, PT/PTT (if bruising or had head CT)
  - Brain MRI and opthalmology exam depending on history and physical exam
  - Admit if medical concerns or cannot find safe place

Medical Evaluation for Suspected Non-Accidental Trauma

- ≥ 2 years old:
  - Selective testing depending on injuries and mechanism
  - Admit if medical concerns or cannot find safe place to stay

Non-Accidental Trauma

- Mandatory reporting to agencies
  - Domestic Violence and Victim Support Unit of the Ghana Police Service
  - Social Welfare Department
- 50% of maltreated children who died had previous episodes that went unreported

Summary

- Children are more likely to suffer from blunt mechanisms of injury and thus multisystem injury
- Similar to management of trauma in adults, remember the ABCs
- The airway in children and large occiput make airway positioning a little more difficult
- Children have amazing cardiovascular reserve but can decompensate quickly
- Do not forget to consider non-accidental trauma

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