



Rapid Pediatric Trauma Emergency Assessment for the EMS Provider

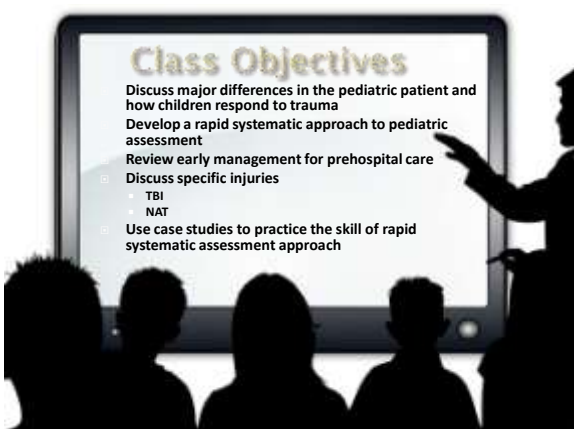
Dusty Lynn, RN, BS, CCRN, CPEN, NR EMT-P
 University of Virginia
 Trauma Program
 RN Coordinator



EMS Pediatric Calls



Pediatric Trauma Calls



Class Objectives

- Discuss major differences in the pediatric patient and how children respond to trauma
- Develop a rapid systematic approach to pediatric assessment
- Review early management for prehospital care
- Discuss specific injuries
 - TBI
 - NAT
- Use case studies to practice the skill of rapid systematic assessment approach

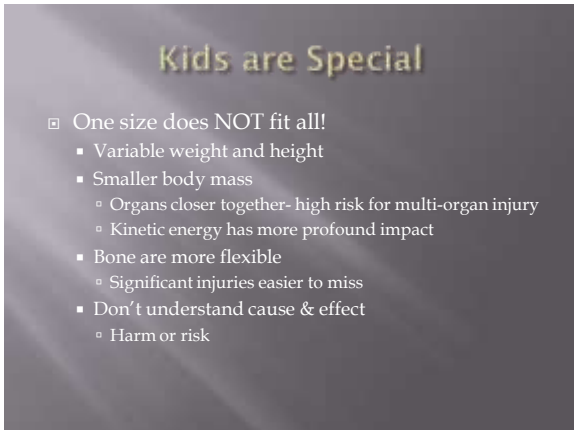


Children are just small adults

Know the main differences in anatomy and how they would affect responses to trauma & illness

Do not go by memory- carry a reference for:

Weight estimation
 Vital signs
 Equipment sizes
 Medications
 &
 Review review review...



Kids are Special

- One size does NOT fit all!
 - Variable weight and height
 - Smaller body mass
 - Organs closer together- high risk for multi-organ injury
 - Kinetic energy has more profound impact
 - Bone are more flexible
 - Significant injuries easier to miss
 - Don't understand cause & effect
 - Harm or risk

However, like adult calls...

BSI

- ☐ Scene Safe and scene size up
- ☐ General Impression + immediate life threats
- ☐ Primary Survey
- ☐ Patient priority
 - Rapid trauma survey with immediate transport/ "load and go"
 - Focused exam
- ☐ Secondary survey
- ☐ Reassessments

Pediatrics... Defined... Sort of

- ☐ Neonates: birth to 1 month
 - Except for NRP
- ☐ Infants 1 mth- 12 mths
- ☐ Toddlers: 1-3 yrs
- ☐ Preschoolers: 3-6 yrs
 - Except for school systems
- ☐ School age: 6-12 years
 - But what about the 50kg 9 year old???
- ☐ Adolescent: 12- 18
 - Except for pediatric trauma centers



Pediatric Trauma Epidemiology & Mortality

- ☐ Leading cause of death in children
- ☐ 50% children who die, die on scene
- ☐ Platinum 30" matter
- ☐ Head traumas are a leading cause of death
- ☐ Abdominal trauma most common form of trauma



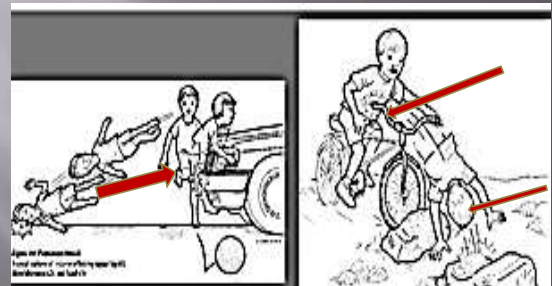
Most Pediatric Common Emergencies

- ☐ Neonates
 - Infection, neglect
- ☐ Infant
 - Infection, neglect, abuse
- ☐ Toddler
 - Poisoning, Fall
- ☐ Preschool
 - Poisoning, Fall, Peds struck
- ☐ School age
 - Ped struck, Fall, Recreational sports
- ☐ Adolescent:
 - MVC, OD, Recreation

Most Common Pediatric Trauma

- < 4 years: Drowning leading cause of death
- 5-9 yrs Pedestrian struck leading cause of death
- Blunt trauma often involves TBI in kids

Patterns of Injury



Why DO we miss important assessment information?

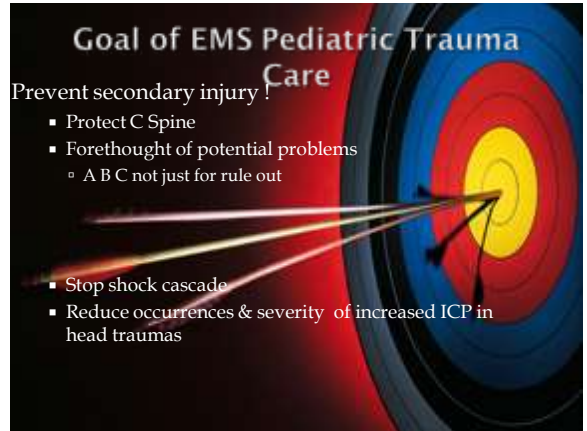
- Lack of systematic approach
- Pediatric calls can be *stressful*
 - Parents/ family members stressed
 - Rarely used equipment
 - Rarely practiced/ used skills
 - Initial responses to severe injury can be subtle



Goal of EMS Pediatric Trauma Care

Prevent secondary injury!

- Protect C Spine
- Forethought of potential problems
 - A B C not just for rule out
- Stop shock cascade
- Reduce occurrences & severity of increased ICP in head traumas



General Principles of Care

- Be Prepared
 - Practice/ Simulations/ Review
 - Know your available equipment
 - Carry a reference
 - vs
 - Weight
 - Equipment
 - Medications
- Age ≤ 8: (Age x 2) + 8 = weight in kg
 Age ≥ 8: Age x 3 = weight in kg
- Retrospective Review
 - Case review- Discussions, Video review
 - Self review

Spinal Motion Restriction

- Lift torso with padding for proper neck alignment
 - Avoid passive flexion
- Limit movement
- Allow for proper ventilation
 - Beware of straps
- Prevent aspiration



external meatus aligned with shoulder
 =
 neutral spine position



Airway

Big tongue +
 Big head +
 More secretions +
 Small, Narrow, short
 airways =
 Many Ways to Obstruct



Children are Special

- Infants are nose breathers, they don't mouth breathe well
 - Short neck
 - Small mandible
- Epiglottis is more U shaped
- Airway is funneled shaped
- Shorter
- Angled vocal cords
- More anterior
 - Easier to obstruct with over extension

Airway Assessment

- Is it patent? Are they at risk for it not to be?
 - Position
 - Capnography
 - Sats
 - Beware of occult foreign bodies

What is the most common cause of airway obstruction in the pediatric patient?

Airway Interventions

- Open airway
 - If not patent:
 - Maintain spinal motion restriction, jaw thrust, suction.
 - 100% oxygen. If they take an oral airway, they need to be ventilated.
- Positioning- unconventional techniques
- Suctioning
- Oral airways
- Intubation

Pediatric RSI

- Preoxygenate!!
- Prepare & Contingency Plan
 - Assessment & exam
 - Hx-
- Pretreat with RX
 - Atropine- for all < 1yr, any < 5yrs receiving Succ, > 5yrs w/ 2 doses of succ
 - Sedation and paralysis (except unresponsive)
- Airway protectin and positioning
- ETT placement & Confirmation
- Post intubation management

Rapid sequence intubation (RSI) in children

Author
Dewesh Agrawal, MD
<http://www.uptodate.com/contents/rapid-sequence-intubation-rsi-in-children>



Intubation

- More Anterior
 - Easy to obstruct with over extension when intubating
- Diameter smaller, with larger tongues
- Trachea short & funnel shaped-
 - Easy right stem intubation
 - Tube easily dislodged
- DOPE



Large Floppy Epiglottis

Miller blade is designed to LIFT the epiglottis
Mac is designed to encourage the epiglottis to move

Breathing Assessment



PEARLS: Kids are more likely to die from hypoxia

- Progression of respiratory distress to failure then arrest ensues quickly
- One of the first signs of hypoxia and shock is AMS & /or tachycardia

Children are Special..

- ▣ Lungs are less compliant
- ▣ Ribs are more compliant
 - Pliable thoracic cavity & mobile mediastinum
 - Occult injuries common
 - High risk for tracheobronchial injuries, especially tension pneumothorax
 - Weak accessory muscles= poor reserve
 - Horizontally aligned ribs- diaphragm dependent belly breathers. Less abdominal fat- organs move upward when supine
 - Pulmonary contusion common
 - Gastric distention & positioning quickly effects WOB
 - Increased metabolism= ↑ O2 consumption
 - Less tolerant of hypoxia

Respiratory Exam

- ▣ Assess
 1. WOB
 2. BBS
 3. RR- breathing at an adult rate may mean impending respiratory FAILURE
- ▣ Respiratory Distress?
 - ↑ WOB- BEWARE of irregular breathing patterns
 - BBS
 - ↑ or ↓ in RR
 - Grunting: Exhaling against a partially closed glottis in attempt to generate PEEP & preserve resting lung volume. *Always indicator of severe illness*
- ▣ Respiratory Failure?
 - Cyanosis
 - Poor ventilation
 - Head bobbing = impending failure
 - Apnea OR gasping = Respiratory ARREST

Breathing Problems

- ▣ Apnea/ Gasping = (CHECK A PULSE)
 - Obstructed airway
 - Position
 - Foreign body
 - TBI/ICP
 - General prolonged hypoxia
 - Pneumothorax
 - Tension pneumothorax



Interventions

- ▣ Protect C spine
- ▣ Suction
- ▣ Prevent respiratory arrest
 - Do not constrict abdomen or chest with securing devices
- ▣ BVM
 - Avoid soft tissue occlusion
 - Pressure- ocular, airway
 - Fingers, mask



Advanced Respiratory Interventions

- ▣ Size of ETT
 - $(Age + 16) \div 4$
 - Size of pinky finger
 - Size of nasal
- ▣ Needle decompression



Cardiovascular Assessment it's All About Perfusion....



PEARLS:

- A pediatric patient can be in life threatening shock & still have a normal BP
- HR is one of the 1st VS to change when a child is sick
- Hypothermia ensues quickly and can be the cause of PEA arrest in a sick child

Children are Special

- Metabolism
- HR
- BP
- Thinner skin
- 70-80cc /kg blood volume



Circulatory Assessment

Observation of Color
&
Hands On Assessment

- Compare pulses-
 - Central vs. distal/peripheral
 - Effected by
 - Edema
 - Large body size
 - HR
- Skin temp
- Capillary Refill time
- Blood pressure



Color/ Circulation



Color/ Circulation



Mottling

Blood Pressure

	Lowest acceptable Systolic pressure
0 – 28 days	60
1 month – 1 year	70
1 year+	70 + (2 x age in years)

Diastolic Pressure should be 2/3 systolic



8-lb Newborn = 3.64-kg
Total circulating volume = 364-cc/ml
Soda can= 335 cc/ml

60-lb Child = 27-kg
TV = 2.2-L
2-L Soda bottle

125-lb Adult = 56-kg
TV = 4.5 L
two 2-L Soda bottles

Response to Hypovolemia

- 10-15% loss of volume:
 - Mild tachycardia, prolonged CRT, skin cool, mottled
 - anxious, irritable, confused
- 30%
 - Severe Tachycardia, diminished peripheral pulses, **hypotensive**
 - Minimal response to pain
- 30-45%
 - Narrow pulse pressure, weak central pulses
- > 45%
 - Profound hypotension, pale, cold skin, bradycardic
 - Coma

Pediatric Definition of Shock

Tachycardia + Poor
Perfusion =

SHOCK

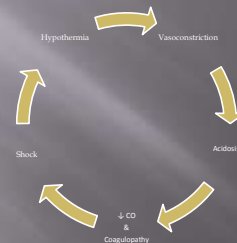
Note that Pediatric patients can be in severe shock and still have normal blood pressure!



Disability...

- Kids have a larger body surface area to size:
 - Set up for hypothermia
 - Immature temperature regulation
- Larger head to body ratio:
 - Higher risk for TBI

Pediatric Hypothermia Cascade



Level of Consciousness

Responsiveness to
stimulation

Awake- alert without
stimulation

Verbal

Pain

Unresponsive



Children who are quiet after a traumatic event are most always in shock



Level of Consciousness



Level of Consciousness



This is the normal response in a child who has been hurt

Exposure & Emotions



Secondary Survey & Reassessments

Done En Route to Trauma Center

- ▣ Head to Toe eval
- ▣ SAMPLE
- ▣ H's & T's
- ▣ ABD decompression
- ▣ Additional IV site
- ▣ Look for missed injuries



IF a Child decompensates at any point, go back to the A B C assessment!

Secondary Assessments

- ▣ Remember: atropine (if given for RSI) will dilate pupils but does not cause FIXED pupils
- ▣ Some life threatening injuries may be missed on the initial A B C exam (ie open chest wound) do not move on to next phase of care until initial A B C's are stabilized
- ▣ If your intervention did not stabilize the problem, recheck your intervention, then look for another reason for the problem

2015 AHA Recommendations

- ▣ The available evidence does not support the routine use of atropine preintubation of critically ill infants and children.
- ▣ *It may be reasonable for practitioners to use atropine as a premedication in specific emergency intubations when there is higher risk of bradycardia (eg, when giving succinylcholine as a neuromuscular blocker to facilitate intubation).* ([Class IIb, LOE C-LD](#))
- ▣ NEW: OCT 2015
- ▣ *A dose of 0.02 mg/kg of atropine with no minimum dose may be considered when atropine is used as a premedication for emergency intubation.* ([Class IIb, LOE C-LD](#))
- ▣ This new recommendation applies only to the use of atropine as a premedication for infants and children during emergency intubation.

Secondary Assessment

- Abd tenderness could indicate significant trauma
- Abd distension- consider significant trauma until proven otherwise.



H's & T's

- Not are they only the reason a child could present in extremis, they are also the reason they could decompensate while in our care

- | | |
|---|---|
| <ul style="list-style-type: none"> • Hypoxia • Hydrogen ion - acidosis • Hyperkalemia/ Hypokalemia • Hypothermia • Hypoglycemia & other metabolic disorders • Hypovolemia | <ul style="list-style-type: none"> • Tablets/ TOXINS • Tamponade (cardiac) • Tension pneumothorax • Thrombosis, coronary (ACS) • Thrombosis, pulmonary(embolism) • Trauma |
|---|---|

Having a well practiced systematic approach keeps everyone focused on the priorities on hand



Traumatic Brain Injury

- 1 million children evaluated yearly- 7000 pediatric deaths per year
- 80-90% are mild
- Most common cause of mortality and morbidity
- Etiology:
 - Infants: abuse
 - Toddlers: abuse and falls
 - School aged: play and sports injuries and MVC
 - Adolescents
 - MVC and assaults
- Predisposed
 - Large heads
 - Poor neck muscle control
 - Thin, pliable skulls

Pathophysiology

- Acceleration
 - Stationary head is hit by moving object
 - Least fatal
- Deceleration
 - Moving head hits stationary object
 - Most severe for brainstem injuries
- Rotational
 - Vigorous back and forth movement
 - Head hit at an angle
 - Diffuse injury, large SDH
- Direct blow
 - Causes fracture
 - Meningeal artery or dural venous tear causes EDH

Munro-Kellie Doctrine

- In the skull:
 - Brain
 - Blood
 - CSF
- Cushings triad



Pediatric TBI Interventions

- Level I = MUST DO!
 - Monitor Sats
 - Maintain IV
 - Give pain & sedation Rx
 - Monitor Capnography



Level II Should be Considered

All the previous intervention AND:

- Avoid Steroids (often given prior to extubation)
- Avoid Hypothermia (DCR)
- Consider 3% NS for increased ICP, ulcer prophylaxis, TF, foley

Level III May be Considered

(Who knows??) all the previous +

- ICP Monitoring, ICP drain, HTS, pressors, paralytics, ventilation
- Sz Rx, Diuretics



Avoid Secondary Injury

- Single episode of hypotension or hypoxia can increase risk of mortality by 150 %
- Airway & C Spine
 - Control
- Breathing
 - Beware of gastric distention= vomit= ↑ ICP= Secondary injury
- Circulation
 - Treat hypovolemic shock aggressively

TBI Treatment

- Prevent secondary injury
- Cardiovascular: 1 episode of hypotension doubles mortality
 - Avoid hypotension and hypoperfusion
 - Assess frequently, shock occurs BEFORE hypotension
 - HOB 30 degrees
 - Correct coagulopathy
 - Volume
 - Pressors
 - Keep MAP > 50 infants > 60 child > 70 in adolescent

TBI Treatment

- Establish spinal movement restriction
- Establish airway control
- Monitor ETCO2 & Pulse ox immediately
- 100% FIO2 for all pediatric TBI
 - Avoid hypoxia
 - Avoid hypo and hyper ventilation. ETCOs 35-45
- Avoid hyperglycemia & hypoglycemia
- Avoid hyperthermia & hypothermia
- ? Decompressive craniotomy
 - ? Saves pt ? Not brain

Signs of Increased ICP

- ☐ Neuro Changes
 - A V P U
- ☐ Pupils
- ☐ Vomiting
- ☐ Cushings triad

Herniation Syndromes

	Eye findings	Gross motor	Respiration
Uncal (lateral transtentorial)	Ipsilateral fixed pupillary dilatation and ptosis	Contralateral hemiparesis	Irregular
Diencephalic	Small midpoint pupils, but reactive to light	Decorticate posturing, hypertonia	Cheyne-Stokes (episodes of apnea and tachypnea)
Midbrain	Midpoint fixed pupils	Decerebrate posturing	Hyperventilation
Medullary	Dilated and fixed pupils	No response to pain	Irregular or gasping

Hyperventilation

- ☐ Transient or bridging hyperventilation only indicated in cerebral herniation
 - Decerebrate posturing
 - Rapidly decreasing GCS
 - Flaccid (motor score of 1)
 - Unequal pupils or fixed and dilated pupils
 - ETCO₂ > 30-35
- ☐ Ventilate
 - Infants 35 bpm
 - Children 30 bpm



Hypertonic Saline

- ☐ Hypertonic saline decreases ICP
- ☐ Preserves intravascular volume
- ☐ Theoretically restores normal cell resting membrane potential, inhibits inflammation stimulates atrial natriuretic peptide release and enhances cardiac output
- ☐ 0.1- 1 cc/kg/ hr or 1-6 cc/kg bolus
- ☐ Keep serum osmolality < 360

Non Accidental Trauma

Exact numbers hard to detect-est. 10% of ED visits from trauma in children <3 yrs are NAT
 40% have no signs of external trauma on initial exam
 80% of deaths from head trauma in children <2yrs are NAT Injuries

1. Skin lesions
2. Head trauma, injury
3. Fractures

EMS Calls & ED Visits

CHIEF COMPLAINTS

- ☐ Viral gastritis
- ☐ Seizures
- ☐ Flu
- ☐ Accidental head trauma
- ☐ Rule out sepsis
- ☐ Injuries

INJURIES FOUND

- Femur fx in children <1yr
- Humeral shaft fx in <3 yr
- Sternal fx
- Posterior rib fx
- Digit fx in children who are non ambulatory

High Suspicion

- Story inconsistent with child's developmental ability
- Exam pts carefully for acute and chronic trauma
 - Femur fx in children < 1yr
 - Humeral shaft fx in <3 yr
 - Sternal fx
 - Posterior rib fx
 - Digit fx in children who are non ambulatory

Shaken Baby Syndrome

- Life threatening injury in children <2yrs
- Mechanism
 - shaking the baby back and forth causing rapid acceleration and deceleration of the cranial contents against the skull. Shearing injuries of vessels, cervical spine injury and intraocular injury results.
 - C/C: "not acting right", sleepy, lethargic, seizures
 - Often no external signs

NAT

- Careful documentation
- EMS Report to ED

Take Home Points

- ① Children are not little adults
- ② Recognize children can decompensate in minutes
- ③ Having a well rehearsed systematic method of assessment & treatment priorities saves lives



New Concepts in TBI

- DCR- Damage Control Resuscitation
- Hemostatic Resuscitation: Improving Outcomes by Early Reversing of ATC-(Acute Traumatic Coagulopathy) -
 - Early Hemorrhage Control- DCS
 - Permissive hypotension
 - Limit dilution by limiting fluids
 - Target Coagulopathy
- 23.4% HS for rescue bolus 0.75cc x kg over 30" (instead of Mannitol)
- Avoid hypercloremia
- Care may be guided by biomarkers

References

- <http://www.uptodate.com/contents/rapid-sequence-intubation-rsi-in-children>
- <http://www.acestar.uthscsa.edu/institute/su12/documents/fri/36%20Vinson.pdf>
- <https://www.youtube.com/watch?v=9T7jQM0T5jI>
- <https://www.youtube.com/watch?v=MxeStUoWqE4>

The End



DLynnRN@virginia.edu