Explosion in a building housing a day care center..... You are handed this child..... Would you be ready .....?

**Objectives**
1. Unique A&P and predisposition to injuries
2. Primary assessment of peds trauma pt
3. Hypoperfusion: recognition/management
4. Priority: ABC’s
5. SMR – who, when, and how
6. Safe securing and transport

**Why this class is important for you**
- Most frequent cause of death in children is traumatic injury
- High acuity/low frequency
- Unique peds anatomy & physiologic response to different types of injury
- Awareness of unique A&P, and MOI, guides assessment and anticipation of injuries

**Mechanism of Injury**
Important because it predicts injury patterns. Awareness of mechanism translates into anticipation of injury and directs your assessment.

**Approach to Assessment for All Peds Trauma:**
Assume that all kids who sustain trauma have a life-threatening event until it is ruled out!

**Assessment: Peds Initial Trauma Care SOP**
- Gen impression
- LOC, c-spine
- Obvious bleeding (C-A-B-C-D-E)
- A = ensure secure and patent
- B = ensure oxygenation / ventilation
- C = ensure adequate perfusion, cellular fuel
- D = assess GCS, pupils, pain mgmt, glucose
- E = expose to assess, keep warm (p 86-87)

**Unique Pediatric A&P: Head Injury**
- Younger heads larger, heavier
- Higher center of gravity
- Weak neck muscles
- Open fontanelles (< 18 mo)
- Thin, non-fused cranial bones
- Neural tissue not fully myelinated
- Scalp highly vascular
Implications and Unique Injury Patterns

- Lead with their heads (falls, deceleration)
- May exsanguinate from scalp laceration
- Hypovolemia w/ epidural bleed < 18 mo.
- Brain easily injured w/o myelin to protect
- Significant brain swelling w/o typical S&S
- EMS plays crucial role in preventing “secondary” head injury (ABCD’s)

Secondary Brain Injury

Results from inadequate oxygenation, ventilation, perfusion, blood glucose extremes

Your most important role: PREVENTION
- Ensure adequate ventilation / oxygenation
- Maintain SBP > 70 + 2X age
- Treat hypoglycemia

One episode of ↓BP has greater effect on peds compared to adult

Assessment: Inspect & Palpate

- Size, shape, contour of skull, face (DCAPBLSTIC)
- Fontanelles
- Eyes: telecanthus; obvious globe injury
- Pupils: changes occur later
- Face: symmetry; mobile segments; drainage
- Oral: teeth; malocclusion; trismus; trauma; bleeding gums
- Drainage/fluid/secretions
- Ears: trauma; otorrhea; Battle’s sign

Assessment: AVPU

A: The patient is awake.
V: The patient responds to verbal stimulation.
P: The patient responds to painful stimulation.
U: The patient is completely unresponsive.

Bleeding from Head Wounds Can Lead to Hypotension in Kids!

Large scalp lacerations
Epidural bleeds in infants
If child w/ head trauma is hypotensive from the start, and the laceration and or blood loss is not large, LOOK ELSEWHERE for the bleeding source!

Traumatic Brain Injury

2,600 deaths; 30,000 life-long disability
Spectrum of brain insults: bleeding and diffuse axonal injury (DAI)
DAI is most common
- microscopic axon damage
- Not evident on CT
- Potentially devastating
All can cause cerebral edema

Assessment: AVPU

Concussion: What is It?

Definition debate:
- TBI w/ ↓ degree of diffuse structural change?
- Damage from reversible physiologic changes?
Rapidly evolving injury in the acute phase, w/ rapidly changing clinical S&S
Evolving knowledge & recommendations
Diagnosis requires assessment in multiple areas of functioning (cognitive, physical)
Concussion

Neuro disturbances (memory problems, ataxia, delayed responses, dizziness) are due to disruption of metabolism, ionic movement, and physiologic responses in the neurons.

Concussion: Features

- Impulsive force transmitted to head
- Rapid onset brief impairment of neuro function that resolves spontaneously
- Resolution / impairment may be prolonged
- Range of S&S evolve over minutes to hours
- Functional disturbance but NOT structural injury
- No abnormality seen on imaging
- May or may not have loss of consciousness

Concussion: Acute S&S

- Headache
- Confusion
- Dizziness
- Amnesia
- N&V
- Fatigue
- Irritability
- Drowsiness
- Slowed reaction
- Balance impairment

Concussion Management

- Activity restrictions have changed!
- Brief period of rest (24-48 hrs)
- Gradual ↑ activity below level of symptoms exacerbation threshold
- Progress to next level no sooner than 24 hrs
- Avoid vigorous exertion
- Successful return to school should precede return to sports/activities
- Return to full activity/sports upon physician’s OK

EMS Responsibility

- Recognize S&S
- Assess for spine injury
- Encourage transport
- Support removal from play
- Rapid sideline assessment
- Urgent follow up w/ MD
- Refusal? Observed by adult

Pedestrian MOI: Waddell’s Triad

Pattern of injuries in high-velocity blunt trauma

Child tends to turn toward impacting object

#1 Bumper impacts legs, pelvis
#2 Torso impacts hood of vehicle
#3 Child propelled downward, striking head

Predictable Injuries

#1: Fx pelvis, femur; internal hemorrhage
#2: Chest, abd, facial, head & neck injury
#3: Head/neck/spine injuries, fractures

Significance: Potential for large amounts blood loss
Unique Pediatric A&P: Chest and Thorax

Chest wall elastic & flexible – underlying structures unprotected
Fractures uncommon
Fragile lung tissue & thin chest wall
Diaphragm rises near nipple line on expiration
Aerophagia

Implications
Frail lung tissue & lack of protection results in
- Pulmonary contusion
- Pneumothorax or hemothorax
- Spleen or liver injury
- Myocardial contusion
Rib fx requires tremendous force – high suspicion for injury!
Significant internal injury can be present without external injury findings
Easily transmitted breath sounds – may miss critical exam findings

Unique Peds A&P: Abdomen

Organs large, closer together
Liver & spleen highly vascular
Thin, weak, pliable abd wall + immature abd muscles = less protection
Pliable ribs and pelvis = less protection
Kidneys anterior, lack protective fat

Implications
Deep penetration of blunt force occurs w/ no sign of surface trauma
Liver, spleen, and lungs easily injured (unprotected)
Close proximity of organs → single blunt force injures multiple organs
Hemorrhage presentation may be subtle – exam + hx + mechanism very important
Reliable exam hampered by guarding, pain, fear
Anticipate resp distress / impairment

Assessment: Inspect & Palpate

Gen rate, depth, effort/WOB
Lung sounds; symmetry; accessory muscle use
SpO2, ETCO2
Inspect:
- deformities
- abrasions
- burns
- swelling
- discoloration
Palpate:
- Tenderness, swelling, instability, crepitus

Assessment

S&S: pain, cramping, N&V, distention
Inspect:
- ecchymosis, tire tracks, seat belt marks
- bruising (navel, flank=retroperitoneal hemorrhage)
- contour/symmetry (msr across navel)
- puncture wounds/intactness of skin
Palpate:
- tenderness, guarding, rigidity, rebound tenderness
- Done w/ side of hand, clockwise from quadrant away from pain

Unique Pelvis/GU A&P and Injury

- Risk for massive bleeding (occult!)
- Bladder location in peds (intra-peritoneal) lends to easy injury
- Kidneys vulnerable: mobile, poorly protected
- Suspect accompanying abd injury w/ findings of pelvic injury
- Suspect bowel, bladder injuries, lower spinal

Needle Thoracostomy in Peds

2nd Intercostal Space

Sternal Angle

Similar to procedure in adults. Catheter size: 14 G
Assessment

- S&S: pain, urge to void
- Inspect:
  - contusion, discoloration, soft tissue wounds
  - scrotal edema, priapism
  - blood at meatus/vaginal outlet
  - perineal edema, butterfly-shaped hematoma
- Palpate:
  - gentle downward outward pressure on iliac crests
  - gentle depression on symphysis pubis
  - TIC
- Pregnant?

Unique Spine/Cord A&P

↓ neck muscle mass: can’t restrict rapid motion
Flat/horizontal spinous facets
+ flexible ligaments
+ Elastic spine cartilage
↓
vertebral bodies slide forward → Cord damage w/o xray evidence (SCIWORA)

Predictors of C-Spine Injury

- Neck pain
- Substantial torso injury
- Predisposing conditions
- Shallow water diving accidents
- High speed MVC, esp w/ ejection
- Torticollis
  - neck stiffness w/ 1-sided spasm
  - head tilts to 1 side
  - indicative of muscle, ligament injury

Hypoperfusion in Peds Trauma

Solid abd organ hemorrhage is most freq cause
Other etiologies:
- pneumothorax
- spine injury
- cardiac contusion or tamponade
BP not your best indicator (very late indicator!)
Strong catecholamine capabilities
If hypotensive, suspect decompensated shock
Role of MAP not yet determined for peds

Pediatric SMR

Anticipate need for padding, support
Padding helps align airway, spine
SMR: entire body secured and supine
No straps / tape across lower chest, abdomen
Avoid restraints that impair ventilation
Leave room for chest expansion
If C-collar does not fit properly, secure by other methods

Unique Spine/Cord A&P Injury Implications

Assess resp function frequently!
Injuries usually @ cervical level
Assume SCI in any unresponsive child
Motor, sensory deficits may mask injury! Assess!
50% occur WITHOUT spinal fx
Injury often partial, initially asymptomatic!
Detailed exam is essential!
Unique Physiology: Perfusion

- Same volume loss as adult = larger total % loss
- Less Hgb = less O2 carrying capacity
- Compensatory mechanisms
  - ↑ HR
  - Vasoconstriction
- Best indicators of hypoperfusion:
  - Sustained tachycardia
  - Cool/cold and pale or mottled skin
  - Mental status change

Pediatric BP Measurement

Accuracy requires properly sized cuff
- Cuff too small → falsely high reading
- Opt for next size larger if one is too small
- Avoid choosing cuff based on “age group”
- Place cuff over midpoint of upper arm
- Bladder length covers 80-100% arm circumference
- 2-3 cm space for stethoscope

Pediatric BP Cuff Sizing

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BP Cuff Sizing

Pediatric BP

Minimum SBP heralding hypotension is 70 + 2X age in years

Pediatric BP Measurement

- Accuracy requires properly sized cuff
- Cuff too small → falsely high reading
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TAKE HOME POINT

Child may be in shock despite a normal BR. Shock assessment is based on clinical S&S, not just a BP reading!

Assessments:
- Pulses: rate, quality, central/peripheral
- Pulse pressure
- Mental status: restless, irritable, lethargic, unconscious
- Skin color, temp, moisture
- Cap refill if warm

Overview of Recommendations

For each situation, there are two options presented.

- The Ideal - This is the ultimate goal for safety and appropriately transporting children in emergency ground ambulances and is the first option for transporting a child in each of the five situations.
- If the Ideal is not Practical or Achievable - This recommendation provides guidance to EMS professionals for the safe transportation of children if the Ideal can not be achieved.
The ACR4

The only ambulance child restraint that meets interim guidance from NASEMSO
The ACR4
- Accommodates pts weighing 4lbs – 99lbs
- 4 color-coded restraints for size ranges
- Allows complete access from the airway to the waist while the patient remains restrained
- Restraint tightens in the mattress of the stretcher, not into the child
- Fully adjustable

The ACR4
- Works on any stretcher or backboard, without a bracket
- Replaces the need to carry multiple devices to restrain all size pediatric patients
- Fully crash-tested under the strictest of standards
- Machine washable

ACR4

Peds Trauma Assessment

Activity
Secure child to your cot using agency-specific equipment. The patient requires continuous accessibility for monitoring and interventions.

Is there any information that you still need?