Pediatric Trauma Assessment

Brian Rogge RN, BSN, EMT - P

Pediatric Trauma

• #1 Killer of children after neonatal period
• Priorities same as adult → ABC’s

Objectives

• Discuss the epidemiology of pediatric trauma
• Review the primary survey
• Identify priorities in care
• Discuss differences between adult & pediatric trauma
• Discuss pediatric trauma management
• Review the development of and guidelines for transport

• Pre-hospital providers often have:
  – Limited pediatric patient contacts
  – Limited knowledge, training, and experience specifically directed towards pediatrics
• Many other healthcare providers are similarly affected
• Children are not little adults!
• Neonate: Birth to 1 month
• Infant: 1 - 12 months
• Toddler: 1 - 3 years
• Preschooler: 3-6 years
• School age: 6 - 12 years
• Adolescent: 12 - 18 years

• Function of Age & Development
  – Does not yet understand harm or risk
  – Does not yet understand cause and effect
  – Feeling of invincibility

• Injury is the leading cause of death in children and young adults

• 1/2 of the injuries result from motor vehicles

• Neonate: infection, neglect
• Infant: infection, neglect, abuse
• Toddler: poisoning, fall
• Preschool: poisoning, fall, pedestrian
• School Age: pedestrian, fall, recreation
• Adolescent: MVA, OD/poison, recreation

• Traumatic injuries often involve blunt trauma to the head
  – Drowning leading cause of death < 4 years
  – Pedestrian leading cause of death 5 - 9 years

• Injuries from falls, motorized vehicles, bicycles, sports

• Mechanism & kinematics are critical
  – serious injuries in a child may not be evident initially
Waddell’s Triad

Pediatric Assessment Triangle

- **Appearance** - mental status, appropriate for age, body position, tone
- **Breathing** - visible movement, effort, audible sounds
- **Circulation** - skin color

Consider the possibility of serious injury if:

- the injured child has altered mental status or appears behaving inappropriately initially
- there is significant mechanism regardless of whether there are obvious injuries
  - Don’t assume the child has an isolated injury
- the injured child has evidence of poor systemic perfusion
General Assessment

- Observations of the child, family and environment are critical!
- Sick/Not Sick – Sick kids look sick
- Maintain distance
- Talk to parents. Keep child with parent
- Is the behavior appropriate for the child’s age?
- Are they consolable?
- Mental status and ABCs are critical!

Focused Exam

- Vitals signs are age dependent
  - Use pediatric vital signs charts
  - Broselow Tape

Weight

- Broselow Tape
  - (Age in years x 2) + 8 = Estimated weight in KG
  - (Age in years x 3) + 7 = Larger children

Heart Rate

- Apical auscultation
- Peripheral palpation (brachial)
- Bradycardia + sick child = Pre-morbid state
  - Child < 60
- Tachycardia may be unreliable and result from
  - Fear
  - Pain
  - Fever
Respirations

- Approximate upper limit of normal = (40 – age in years)
- As a general rule > 60/min = Danger!!
- Slow = Danger, impending arrest

Blood Pressure

- Not a good indicator of perfusion in the pediatric patient and is seldom useful

- Assess last; use other assessment findings:
  - Peripheral pulses
  - Skin color & temperature
  - Capillary refill
  - LOC

Temperature

- Normal = 37°C or 98.6°F
- Pediatric pts are more prone to hypothermia due to:
  - Large surface to volume ratio
  - Radiant heat loss
- Cold = Pediatric Trauma Patient's Worst Enemy!
  - Trauma triad of DEATH
    - Hypothermia, coagulopathy, acidosis

- Blood Pressure Lower Systolic Limit
  - (Neonate) 60 mm Hg + (2 x age years)
  - (Infant/Child) 70 mmHg + (2 x age years)
  - (> 10 years) 90 mm Hg + (2 x age years)

- Proper Cuff size
  - Width = 2/3 length of upper arm
  - Bladder encircles arm without overlap
• After exposing the patient during primary and secondary survey, cover the child to avoid hypothermia!

Head
  – Anterior Fontanelle
    • Remains open until 12 to 18 months
    • Sunken when volume depletion exists
    • Bulges with increased ICP

Brief, relevant
  – Signs/Symptoms
  – Allergies
  – Medications
  – Past Medical Problems
  – Last Food or Drink
  – Events Preceding the Illness or Injury
General Assessment Concepts

- Do not forget to talk to the child
- Avoid separating children, parents unless parent out of control
- Use appropriate sized equipment

Communication with a child
- Children understand more than they express
- Watch non-verbal messages
- Get down on child’s level
- Develop, maintain eye contact
- Tell child your name
- Show respect
- Be honest

Anatomical Differences - Airway

- Larger occiput increases neck flexion
- Large, floppy epiglottis
- Larger tongue relative to size of oropharynx
- Children younger than 10 have narrowest portion of airway below vocal cords (subglottic)
- Larynx is anterior

As a result
- Due to epiglottis, straight blade is more useful
- Difficult to lift and control epiglottis with blade
- Subglottic edema, constriction or compression results in significant airway compromise
Pediatric Intubation Considerations

- Uncuffed
  - < 1 year old: 3.5 mm ET tube
  - 1-2 year old: 4.0 mm ET tube
  - > age 2: (yrs/4) + 4 = mm ET tube

- Cuffed
  - < 1 year old: 3.0 mm ET tube
  - 1-2 year old: 3.5 mm ET tube
  - > age 2: (yrs/4) + 3.5 = mm ET tube

- Place in the sniffing position
  - Manually immobilize head in suspected C-spine injury
  - A small folded towel may need to be placed:
    - Under the head of the child > 2 years
    - Under the shoulders of the child < 2 years

- Move the tongue out of the way!

- Lift the epiglottis directly with the blade

- If bradycardia ensues, ventilate adequately before re-attempting intubation

- Pre-treat with Atropine 0.02 mg/kg per your protocol

- Consider NG or OG tube if excessive gastric distention was created by BVM ventilations

- Intubation complications – DOPE
  - D = Dislodgment
  - O = Obstruction
  - P = Tension Pneumothorax
  - E = Equipment failure

- FREQUENTLY reassess…especially with every patient move!
  - Little movement is required to inadvertently extubate the pediatric patient
Tubes migrate with head movement

- Secure tube well
- Immobilize head in neutral position
- Never let go of tube
- ET tubes wind up in mainstem bronchi, due to short trachea

Breathing

- High metabolic rates + Low reserve capacity
  - = high sensitivity to airway/breathing problems
- Oxygenate and ventilate aggressively

• Surgical cricothyrotomy is not recommended in children < 8 - 10 years of age
  • Needle cricothyrotomy is preferred for children, if required at all

• Adequate ventilation and oxygenation are crucial to the seriously injured child
  - Higher demand for oxygen normally as compared to adults
  - Head injuries require adequate oxygenation to minimize secondary injury
• At a minimum, supplemental oxygen is indicated
Simple supplemental oxygen is usually adequate in the spontaneously breathing child
- If the child does not tolerate a mask or nasal cannula, blow-by oxygen is better than no oxygen
- Proceed slowly in the anxious or distrusting child

• BVM ventilation often is sufficient and preferable over ETT
• Complication of BVM ventilation gastric distention
  - May interfere with diaphragm movement
  - Increase risk of emesis & aspiration

• Assessment of the BP
  - Is seldom useful and may be difficult to obtain
    • Assess peripheral pulses
    • Skin color and temperature
    • LOC (Silence is not Golden)
    • Capillary refill
  - Hypotension will be a very late sign in the pediatric shock patient

• Rapid control of external bleeding is essential due to their small blood volume
• Hypovolemic shock may be seen as tachycardia, weak/thready pulse, AND poor skin perfusion or mental status
• Children have excellent compensatory mechanisms - UP TO A POINT!
  - Then they crash…irreversible shock
  - Hypotension is an ominous sign

• Circulation
  • Assessment of the BP
  • Is seldom useful and may be difficult to obtain
    • Assess peripheral pulses
    • Skin color and temperature
    • LOC (Silence is not Golden)
    • Capillary refill
  • Hypotension will be a very late sign in the pediatric shock patient

• Serious injuries may not be obvious externally
• Treatment
  – Oxygenation/Ventilation
  – Fluids: 20 ml/kg as a bolus – may need to repeat
  – Additional vascular access options: intraosseous and umbilical vein (newborn)

#1 cause of death in pediatric trauma
  – Large heads
  – Thin skulls
  – Poor muscle control

• Assess mental status
  – LOC, confusion, irritability/agitation, lethargy
  – Change in pupils

• Glasgow Coma Scale
  – Pediatric modification

• Assess for
  – scalp lactations/bleeding
  – rhino/otorrhea

• Control external hemorrhage

• Monitor for Signs of ICP
  – GCS <8
  – Pupils - asymmetric, dilated or nonreactive
  – Posturing: Decerebrate vs Decorticate
  – Vomiting
  – Bulging fontanelle

*Impending herniation
  • Cushing Response (bradycardia, hypertension, irregular respirations)
• If ↑ ICP suspected
  – Intubate if GCS <8
  – Controlled hyperventilation
    • ETCO2 goal 26-32 (normal ventilation 33-36)
  – Keep neck midline
  – adequate sedation/pain control (avoid shivering)
  – minimize noise & light exposure
  – elevate HOB if possible - Reverse Trendelenburg

• Resuscitate hypovolemic shock aggressively to keep adequate cerebral perfusion

• Rare. Usually at C1, C2, C3. Dislocations more common.

• Suspect if trauma involves
  – Sudden deceleration
  – Head injuries
  – Decreased LOC

• If spinal immobilization is needed, then do it.
  Resist temptation to pick up child and run.

• 2nd only to head trauma as cause of traumatic death

• 90% of pediatric chest trauma is blunt

• Chest wall is thinner and very elastic

• Thoracic muscles & subcutaneous tissue are less developed
  – Rib fractures are uncommon, bones are very compliant
  – Extensive intrathoracic injury (like pulmonary contusions)

• Tension Pneumothorax
  – Hypotension/poor perfusion
  – Unilateral or bilateral decreased breath sounds
  – Tracheal deviation
  – JVD
  – Respiratory distress

• Consider in
  – Blunt or penetrating trauma patients
  – Intubated patients who become suddenly unstable or difficult to bag despite suctioning
  – Patients with known rib fractures and SQ emphysema
• Medical Management
  – Consider RSI for severe respiratory distress
  – If signs of tension pneumo with hypotension and/or decreased oxygen saturation perform NTube decompression

• Needle Thoracostomy
  – 2nd intercostal space at the midclavicular line
  – 5th intercostal space at anterior axillary line

• For infants or small children with minimal SQ tissue, consider a 16 or 18 gauge catheter as an alternative to Cook Catheter

• If tension reoccurs, repeat needle decompression!

• Most common form of pediatric trauma
  – Usually blunt

• Liver, spleen injury more common than in adults
  – Abdominal cavity is small = relatively larger organs
  – Weak abdominal wall

• Assess for contusions, wounds or eviscerated tissues
• Gently palpate to assess tenderness, rigidity, guarding
  – Distention
    • May also be to air swallowing
    • Consider OG/NG placement

• Medical Management
  – Treat hypovolemia and shock aggressively
  – Cover open wounds with dry sterile dressing
  – Cover any eviscerated organs with sterile moist saline dressing
• Priorities ABC’s

• Orthopedic trauma rarely severe enough to warrant attention before head, chest, abdominal injury

• Pedi bones are soft & absorb/dissipate force before fracturing
  – Greenstick fracture common
  – Treat painful, tender or favored extremities as fractures

• Growth plate frequently involved

• Neurovascular injury - most common injury
  – Humerus
  – Femur

• Assess distal pulse, skin color, temp, cap refill, motor/sensory function

• Control bleeding by direct pressure and cover all open wounds with dry sterile dressings

• Pediatric patients have larger BSA
  – ↑ risk of fluid loss
  – ↑ risk of heat loss

• Smaller airway = early & aggressive management

• Parkland Formula
  – \(4 \times \text{wt in kg} \times \% \text{BSA}\)
  – \(\frac{1}{2}\) of this volume should be infused over 16 hours
  – Simplified, for the first 8 hours after injury, crystalloid infusion (ml/hr) = \((\text{wt in kg} \times \% \text{BSA burned})/4\)

• Children are not little adults

• Major injuries involve head and abdominal injury

• ABCs – TREAT AGGRESSIVELY

• Bradycardia is bad

• Are more prone to hypothermia & fluid loss

• A crying kid is good, quiet kids are bad

• Treat them like they are your own kids
Thank You!

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wcsocrow@yahoo.com

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Questions?
Contact: Samantha Roberts
509-242-4264
1-866-630-4033
robertss@inhs.org
Fax: 509-232-8344