Advanced Pediatric Emergency Medicine Assembly

March 23-26 2015
New York, NY

Pediatric Trauma Update and Controversies

The course will focus on a case-based review of the current updates in pediatric trauma. A literature-based review of the current recommendations for the pediatric trauma patient will also be discussed. The speaker will review the PECARN Head and Cervical Spine papers, as well as other current literature reviewing the “pan-scan” use of CT’s and their use in pediatrics. Controversies revolving around the utility of pediatric trauma centers vs. adult trauma centers, utility of designated trauma surgeon, and the importance of family presence during resuscitation also will be discussed.

OBJECTIVES

- Review current literature regarding Pediatric Trauma including head and cervical spine injury.
- Discuss the different ways that family presence can impact the physiology of the injured patient.
- Address controversies regarding the importance of a designated pediatric trauma center.

3/23/2015
9:30 AM-10:00 AM
Grand Ballroom
MO-4

DISCLOSURES:
(+ No significant financial relationships to disclose
Trauma Update and Controversies

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Can You Hear me now???
DISCLOSURES

Challenges Facing Today’s ED

- Total outpt. visits steadily ↑ over last 25 yrs¹
- Most children are cared for in general EDs
  - Only 7% of US hospitals have a separate peds ED²
  - 136 million ED visits annually
    - 40 million for injury
  - EMSC current Peds Preparedness Survey
    - Median Score 2003: 55 → 2013: 69

². CDC.gov. Fast Stats, Feb 6 2015
³. PedsReady.org, Rev. 3/21/2014
Trauma is the leading cause of death in 1-19 yrs

50% of deaths between 5 and 34 years of age

Motor vehicle related accidents account for 50% of pediatric trauma cases

$16 billion is spent annually caring for injuries to children less than 16 years of age
For every 1 death there are:
160 admissions, 2000 ED visits
< 5 yr. highest risk (2 peaks); boys > girls
Blunt > Penetrating
Regionalized Peds Trauma Centers
  » Improved mortality for severely injured

Epidemiology

- Airway and shock management paramount
- Head injury: ↑ morbidity & mortality
- Forces over small area → multi-system injury
- Little or no external injury
- Kids die from hypoxia and resp arrest
- ↑ heat loss, glucose & fluid requirements
- Psych sequelae for EVERYONE!!!
Overall smaller size, more compact organs

- Multiple injuries more common

Proportionately larger head

- Higher frequency of head trauma

Smaller, narrower, funnel-shaped upper airway

- Higher frequency of soft-tissue obstruction

Flatter facets joints, more elastic cervical ligaments

- Greater propensity for spinal cord injury without radiologic abnormality (SCIWORA)

Background (1 of 3)

Thinner chest wall, more flexible ribs

- Higher frequency of pulmonary injury

Horizontal ribs, weaker intercostals

- Young children are diaphragm breathers

More mobile mediastinum

- Tension pneumothorax poorly tolerated

Abdominal organs more anterior and less subcutaneous fat

- Higher risk of intra-abdominal injury and bleeding

Background (2 of 3)
Background (3 of 3)

- Softer bones, thicker periosteum
- Higher frequency of incomplete fractures
- Active, unfused bony growth plates
- Disturbed growth after growth plate fractures
- Compensatory vasoconstriction
- Normal blood pressure with early shock
- Larger body surface area/mass ratio
- Greater heat loss from exposed body surfaces

Areas of Large Hemorrhage

- Hemothorax
  - Large vessels
  - Penetrating chest wall injuries
- Pelvic Fractures
- Penetrating abdominal injuries
- Long bone fractures
• 20 ml/kg crystalloid bolus x 2

• Transfusion Protocols if continued hemodynamic instability
  ◦ Most available literature on trauma care has focused on adults
  ◦ Can we apply concepts from adult care to pediatric care?

Massive Transfusion Protocols
Initial Resuscitation

• Latest Guidelines from 5/2012
  ◦ Indications:
    • > 30-40% of total blood loss
    • >150mL/min
    • Initial resuscitation > 40mL/kilo of PRBCs
    • 1 Blood Volume loss in 24 hrs..
      ◦ 80cc/kg

• “These guidelines have not undergone expert review by the Pediatric Trauma Society and its hosting by the Pediatric Trauma Society should not be considered an endorsement of its content”

Pediatric Trauma Society
Cycle Recommendations

- **5/2012**
  - Cycles 1, 3, 5, etc.:
    - Cycle 2, 4, 6, etc.
      - Cryoprecipitate if Fibrinogen < 1 – 1.5 g/L or > 2 BV
      - Recombinant Factor VIIa if coagulopathic*

<table>
<thead>
<tr>
<th>Patient Weight</th>
<th>PRBCs</th>
<th>FFP</th>
<th>Platelets</th>
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<tr>
<td>&lt; 40kg</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>&gt; 40kg</td>
<td>6</td>
<td>4</td>
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- Cycle 2, 4, 6, etc:

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- **Cryo: 4mL/kg if Fibrinogen < 1.0**
  - fibrinogen, von Willebrand factor, factor VIII, factor XIII and fibronectin

- **Novo7**
  - 90mcg/kg

Average Volumes

- **PRBCs: 360mL/unit**
- **FFP: 250mL/unit**
- **Platelets: 50-60mL/bag (5 – 10 Units)**
- **Cryo: 4mL/kg if Fibrinogen < 1.0**
  - fibrinogen, von Willebrand factor, factor VIII, factor XIII and fibronectin

3/6/2015
Approx. Effectiveness of Products

- **Cryo:**
  - 1 dose of 4ml/kg increases Fibrinogen 0.45g/L

- **Platelets:**
  - Every 10kg requires 1 pack to increase count approximately 50,000/uL

- **PRBCs:**
  - 10 ml/kg transfusion will increase Hgb by 3 g/dl and Hct by 10%

Is Massive Transfusion Protocol Effective?

- **Hendrickson et al.**
  - Emory University
  - Retrospective/Prospective Cohort Study
  - 2009-2010

- **Chidester et al.**
  - Nationwide Children’s Hospital
  - Prospective Cohort Trial
  - 2009 – 2011
Conclusions

- Post-MTP
  - Patients received higher FFP:RBC
  - Decreased length of time to FFP administration (200min →50min p<0.001)

- Neither FFP:RBC, Plat:RBC, or Time to FFP administration affected mortality/survivability

- Higher # of thromboembolic events in Non-MT (Chid)

Retrospective analysis 2003-2010

- Pediatric trauma patients who received PRBCs within the first 24 hrs.
  - LA County University of Southern California
  - Deaths within first 24 hrs. were excluded to remove survival bias

- 6,675 Trauma patients
  - 475 PRBC transfusions (7%)
    - 72 died within 24 hrs. = 403 patients
  - 105 massive transfusions (1.5%) (26.1%)
    - Mean: ICU stay: 14.3 +/- 20.3; age 12.4 +/- 6.3
    - Mortality rate 18.1%
  - Massive Transfusion was considered >50% BV
  - All deceased patients suffered severe head injuries


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<table>
<thead>
<tr>
<th>Ratio group</th>
<th>Plasma/PRBC ratio</th>
<th>Platelet/PRBC ratio</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>AOR (95% CI)</td>
<td>P</td>
</tr>
<tr>
<td>Low</td>
<td>—</td>
<td>.990</td>
</tr>
<tr>
<td>Medium</td>
<td>.91 (.02-.41.42)</td>
<td>.560</td>
</tr>
<tr>
<td>High</td>
<td>.81 (.02-.34.60)</td>
<td>.514</td>
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</tbody>
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Plasma/PRBC ratio regression controlled for GCS score ≤ 8, head AIS ≥ 3, cryoprecipitate units, and platelet units, and platelet/PRBC ratio controlled for GCS score ≤ 8, admission hemoglobin, admission hematocrit, and plasma units.

AIS = Abbreviated Injury Score; AOR = adjusted odds ratio; CI = confidence interval; GCS = Glasgow Coma Scale; PRBC = packed red blood cell.

No difference in mortality among different groups

• Massive transfusion not common:
  ◦ 1.5% of trauma patients
  ◦ 26% of Transfusion patients

• Head Injuries appear to be #1 cause of death, not hemorrhage
  ◦ Most of the 72 excluded most likely died due to hemorrhage

• Platelet:PRBC and FFP:PRBC ratio not related to survivability

• Lack of research/guidelines

**Conclusions - Nosanov 2013**

• Difficult to interpret (Adult to pediatric)

• MTP - no proven to improve mortality in pediatric trauma patients
  ◦ Head Injuries Most Likely #1 cause of death
  ◦ Factor VIIa no apparent effect on mortality
  ◦ FFP:PRBC or Plat:PRBC ratio do not appear to effect mortality

• More studies are required

**Summary**
**Does Mechanism Matter??**

<table>
<thead>
<tr>
<th>Falls &lt; 3 Feet</th>
<th>Falls 3 – 6 Feet</th>
<th>Falls &gt; 6 Feet</th>
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<tbody>
<tr>
<td>couch, bed</td>
<td>kitchen counter standing, chair</td>
<td>Porch</td>
</tr>
<tr>
<td>coffee table</td>
<td>top of slide</td>
<td>changing table</td>
</tr>
<tr>
<td></td>
<td>bunk bed, stairs</td>
<td>baby walker</td>
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</table>

**Injuries that result in intracranial trauma**

- **Highly unlikely**
- **Unexpected BUT Possible**
- **Reasonable**
Exceptions

- Epidural hemorrhage
- Hemorrhage with pre-existing intracranial defect
  - increased extra-axial spaces
  - prior intracranial bleed
  - cerebral atrophy
- Bleeding disorder
- Ruptured AVM or other vascular malformation

What about Non-accidental Trauma?

Fig 2. Retinal hemorrhages may be caused by shaking, head trauma, neoplastic disorders, or resuscitation. The above case was seen following a seizure.
Infants < 2 y/o with intracranial injury
- Chief Complaint / History:
  - lethargy, irritability, poor feeding
- Exam: retinal hemorrhages
  - present in 70-80% of Shaken Baby Syndrome
- C-T: subdural/subarachnoid hemorrhages
- Does the history explain the injuries?

**Whiplash Shaken Baby Syndrome**
*(Caffey 1972 vs. Caffey 1946)*

- Approximately 1,300 U.S. children every year
  - ~20% of cases are fatal in the first few days after injury

- Survivors are left with handicaps
  - ranging from mild to Severe

- Developmentally handicapped: 80-90%

**Morbidity of Shaken Baby Syndrome**
Conclusion

- Differentiating NAT head injury is challenging.
- Children rarely sustain ICH after falls at home.
- Intracranial injury with retinal hemorrhages is rare in traumatic injury.
- Infants can sustain contusions / fractures / ICH from minor falls.

Traumatic Brain Injury (TBI)

- ~1.4 million TBI each year in the U.S.:
  - 50,000 die;
  - 235,000 are hospitalized; and
  - 1.1 million treated and released from ED

- Children 0 -14yrs, TBI results:
  - 2,685 deaths;
  - 37,000 hospitalizations; and
  - 435,000 emergency department visits.¹

http://www.cdc.gov/ncipc/tbi/coaches_tool_kit.htm
Predictors of ICH

- Greene, Pediatrics 1999
  - Scalp hematoma most sensitive clinical predictor

- Quayle, Pediatrics 1997
  - depressed LOC (OR=4), focal neuro (OR=8), skull #, LOC > 5 min, seizure (trend)

- Beni-Adani, J Trauma 1999
  - Scoring system for Bleeds; not validated

- Palchak et al., Ann Emerg Med 2003

Childhood Head Trauma:
A Neuroimaging Decision Rule

Supported by grant R40MC02461-01-00 from EMSC/MCHB/HRSA
42,412 patients under 18 years old

Derivation and Validation

Develop CT Scan rules to identify ciTBI

PECARN, Lancet, 2009

Clinically Important Traumatic Brain Injury

- Death from traumatic brain injury
- Neurosurgery
- Intubation for more than 24 h for traumatic brain injury
- Hospital admission of 2 nights or more associated with traumatic brain injury on CT

Severe

MVC with patient ejection, death of another passenger, Rollover; Struck pedestrian or bicyclist without helmet; Falls of more than 5 ft. for > 2 yrs. & >3 ft. for < 2yrs; Head struck by a high-impact object

Mild

ground-level falls or running into stationary objects

Moderate

any other mechanism

PECARN
PECARN: Age Less Than 2

CT Recommended

- GCS >14 but other signs of AMS or palpable Skull Fx: Yes
  - 13.9% of population
  - 4.4% risk of cITBI

- Occipital, Parietal, or temporal scalp hematoma, or hx of LOC>5s, or severe mechanism of injury, or not acting normally per parent: Yes
  - 53.5% of population
  - <0.2% risk of cITBI

CT NOT Recommended

- Observation vs CT: Based on: Experience
  - Mult. Vs. isolated findings
  - Worsening sx/signs
  - Age <3months
  - Parental pref.

PECARN: Age 2 and Older

CT Recommended

- GCS >14 but other signs of AMS or signs of basilar skull fx: Yes
  - 14% of population
  - 4.3% risk of cITBI

- Hx of LOC, Vomiting, or severe mechanism of injury, or severe HA: Yes
  - 58.3% of population
  - <0.05% risk of cITBI

CT NOT Recommended

- Observation vs CT: Based on: Experience
  - Mult. Vs. isolated findings
  - Worsening sx/signs
  - Age <3months
  - Parental pref.

PECARN: Age Less Than 2

PECARN: Age 2 and Older
Traumatic Brain Injury: Recommended Practices

- Hyperosmolar therapy
- Avoid hyperthermia, +/- hypothermia
- Prevent seizures
  - Reserve pentobarbital for refractory conditions
- Mid-line neck, elevate head of bed
- Treat pain and agitation
  - Consider pre-medication for nursing activities
- Avoid hyperglycemia
- Allow family contact

Head Elevation

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![Graph showing changes in MAP, CPP, and ICP with varying degrees of head elevation](Image)
Respiratory Support: Normoventilation

Hyperventilation: More harm than good?

CBF pre-hyperventilation  CBF post-hyperventilation

Image from: ALL-NET Pediatric Critical Care Textbook
www.med.ub.es/All-Net/english/neuropage/protect/vent-5htm

Originally adapted from research by Skippen et al., (1997) Critical Care Medicine, 25

Skull Radiographs?

- Skull radiographs can be used to identify and classify skull fractures
- Head CT (Standard or 3-D):
  ◦ More accurate for dx Pediatric skull fractures
  ◦ Test of Choice

- Absence of a fracture does not reliably exclude intracranial injury.

Skull Radiographs?
Skull Fracture

- 20 x ↑ risk ICH
  - 50% of parietal fx, 75% of occipital fx
- linear > depressed > basilar
- 90% linear fx → overlying hematoma
- “Growing skull fx”:
  - Diastatic → dural tear → leptomen. cyst
- Depressed fx: may miss on CT

Skull Radiographs

- Meta-analysis of 16 studies:
  - Predictors of ICI with minor trauma
    - Presence of a skull fracture
      - RR = 6.1 (95% CI 3.4-11.2)
      - Neither sensitive (59%) nor specific (88%)
    - Plain radiographs should NOT be used to identify Intra-Cranial Injury.

• 99 pts (11-22yrs) within 24hrs of Concussion
  ◦ Intervention: STRICT rest x5d **VS.**
  ◦ Usual care: Rest x 1-2d, then stepwise return to activity

• 88 completed (45 Usual, 43 STRICT)
  ◦ Neurocognitive & balance scores done at days #3 & 10.


• NO clinical difference:
  ◦ Neurocognitive testing
  ◦ Balance outcomes

• BUT: REST group:
  ◦ More daily post-concussive scores
  ◦ Slower resolution of symptoms
What about C-spine?

Cervical Spine Injuries

- Less common in kids, higher mortality
- Associated with TBI
- Falls > MVC > sports (trampolines)
- <8 yr: 2/3 above C3
- Suspect injury in same scenarios as Adults
- C-spine injuries in children are Rare
- 1.5% of blunt trauma patients
- In young children, be on look out for:
  - High c-spine injury (C1-3)
  - Ligamentous injury
  - SCIWORA

**Epidemiology: Bottom Line**

- 21 centers across the US prospective, observ. study
- Assess the validity of the following five criteria
  1. Absence of tenderness at the posterior midline
  2. Absence of a focal neurologic deficit
  3. Normal level of alertness
  4. No evidence of intoxication
  5. Absence of clinically apparent distraction
- Meet all five criteria = low prob of injury
3065 patients < 18 years (9% of NEXUS)
- Total # c-spine injuries: 30
- 603 / 3065 considered “low risk” (20%)

All low risk patients had negative radiographic evaluations (100% sensitive)
- **Problem:**
  - Numbers are small (95% CI for sensitivity: 87.8% - 100%)
  - Very few injuries in younger kids

**Imaging – Peds subset of NEXUS**

*Viccellio et al (2001) Pediatrics*

**Bottom line:**
- Authors “cautiously endorse” the use of the NEXUS criteria in children >8yo
- Not enough power to ensure that the tool is safe to use in younger children

**NEXUS – peds subset**
1. Altered mental status
2. Focal neurologic deficit
3. Complaint of neck pain
4. Torticollis
5. Predisposing medical condition
6. Substantial injury to the torso
7. Diving accident
8. High-risk motor vehicle crash

Factors associated with C-spine injury in children after blunt trauma

Presence of ≥1:
Sensitivity: 98%
Specific: 26% for cervical spine injury.

Plain radiographs:
- Sensitivity of 90% identifying C-spine injury
- Often the most appropriate initial study

CT is the preferred imaging modality in the injured patient
- Definitive method of diagnosing bony injuries
- Ionizing radiation exposure for CT is 30X higher than for plain radiographs.

X-ray vs. CT?
What should we do with infants?

- NEXUS
  - 88 patients < 2 yo – no injuries

- Nat. Peds Trauma Registry (Canada):
  - children < 2 yo : ~ 8 injuries per yr

- No studies with large enough # for EBM practice recommendations
- Have to go to expert opinion

What should we do with infants?

- See them quickly
- Assess for altered LOC, neuro deficit, distracting injury
- If no injury apparent, remove immobilization equipment in protected environment
- Observe for spontaneous movement of neck
- Most small children will “clinically clear” themselves
ABDOMINAL TRAUMA

- **Blunt vs. Penetrating:** 9:1

- **Organs:**
  - Blunt: Spleen & Liver
  - Penetrating: Colon, small bowel, Liver, Spleen

- **Mechanism:**
  - Blunt: MVC, NAT, Falls, Sports/ recreation
  - Penetrating: GSW, Stabbing
**Focused Abdominal ultrasound in Trauma**
- Quick, easy, non-invasive

**Sensitivity:**
- Adults: 85-90% for intraperitoneal fluid
- Pediatrics: 66-68%

**Prediction Rule (PECARN)**

Safe for Discharge?

- **Horn J 2010**
  - Review 3 studies – 2596 patients
  - Overall risk of intra-abdominal injury w/(-) CT
    - 0.19%
    - NPV: 99.8%

- **Kerrey 2013 (PECARN): 5380 patients CT**
  - 3819 with negative CT
  - NPV: 99.6%

Pediatric Trauma Centers:

- Higher overall survival rates than ATCs
- Difference disappears when the analysis controls for:
  - Injury Severity Score
  - Pediatric Trauma Score
  - Age
  - Mechanism
  - ACS verification status

- ACS-verified centers have significantly higher survival rates than do unverified centers.

*Osler, et al J Trauma. 2001* Do pediatric trauma centers have better survival rates than adult trauma centers? An examination of the National Pediatric Trauma Registry.
Criteria for Transfer to Trauma Center

The Effect of Family Presence on the Efficiency of Pediatric Trauma Resuscitations

- Supported by ACEP and AAP
- Annals of Emergency Medicine, 2009

Family Presence
Family Centered Care

- Family Presence during Resuscitation:
  - Helped recognize the seriousness of condition
  - They feel presence was beneficial
    - They would choose to be present again
  - Helps family adjust to grieving process
  - No delay in patient care


Family Centered Care

The “risk management literature indicates that patients and families are significantly less likely to initiate lawsuits, even when mistakes are made, if there is open and effective communication and trusting relationships between the practitioner and the patient and family”

- NO research has shown the family presence is harmful and evidence is growing that it is beneficial

AAP & ACEP. Patient and family centered care and the role of the emergency physician providing care to a child in the emergency department, Pediatrics 2006
We Are Giving Ourselves Cancer
By RITA F. REDBERG and REBECCA SMITH-BINDMAN  JAN. 30, 2014

Adults age 45 or older

- Very low risk of excess cancer for one scan
- High prevalence of cancer in patients over 45
- May not live long enough to express mutation
- Usually past reproductive age
But for a 10 year old

- Long lifespan in which to manifest mutation
- Immature, rapidly developing body systems, more radiosensitive
- May pass mutations to progeny

  - No Cancer prior to first CT
  - 283,919 CT scans (64% Head CT)
    - Leukemia = 74
    - Brain Tumors = 135
  
  Compared to children with <5mGy RR Leukemia was 3.18 in those received >30mGy
  - Brain Tumor RR 2.82 in those received >50mGy

Radiation exposure from CT Scans in Childhood and subsequent risk of Leukemia and Brain Tumours: A Retrospective Cohort Study. Lancet (2012)
Risks of Ionizing Radiation from Diagnostic Imaging. *Lancet* 2012  Bottom Line

- Absolute risk is small (1/10,000 Head CT)
- Although the risk is small, it is cumulative
  - Statistically significant increase in cancer risks above 50mSv
- The benefits of an *indicated* CT far outweigh the risks

Choosing Wisely campaign

- CT NOT necessary in the immediate evaluation of minor head injuries
  - (PECARN) criteria should be used to determine whether imaging is indicated.
  - Imposes undue costs to the health care system.
- Clinical observation prior to CT decision-making
- Unnecessary exposure to x-rays = danger
  - Increases lifetime risk of cancer
    - Peds brain tissue more sensitive to ionizing radiation.
What Do Families Want to Know?

- The exam is needed to best care for their child
- The risk of the exam is real, but very low
- The exam is being performed with the lowest possible risk

TAKE HOMES

- Severely injured do better at trauma center
  - Multi-system injury is RULE
- Head injuries: high mortality & associated injuries
- Lack of 7 (abdominal trauma) and negative Abdominal CT: Reassuring
- Consideration of NAT must be given in ALL cases
• Brief Rest for Concussed patients may improve timing of resolution of sx’s

• Massive Transfusion Protocols for Pediatrics
  ◦ Limited data
  ◦ Overall: No improved outcomes vs non-MTP

TAKE HOMES

• Family Presence is a GOOD thing

• Ionizing radiation from diagnostic imaging may cause a small increase in the risk of cancer

• For an indicated CT scan, the likely benefit is far greater than the estimated risk

TAKE HOMES
The END

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Questions?
Acknowledgements

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  ◦ Emergency Physician, Alberta Children’s Hospital
- Jeffrey T. Seabourn, M.D.
  ◦ Gem State Radiology
- Alan S. Brody, MD, FAAP
  ◦ Cincinnati Children’s Hospital Medical Center Cincinnati, Ohio
- Michele Holloway Nichols, MD
SYLLABUS for: Pediatric Trauma Update and Controversies

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Director, Pediatric Emergency Medicine Fellowship
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Morristown, N.J. 07962
Emergency Medical Associates

COURSE DESCRIPTION:

This course will discuss the most recent literature pertaining to the pediatric trauma patient. I will discuss recent statistics related to the injured pediatric patient; review how and why the injury pattern is different in a younger patient; I will discuss the literature that reviews mechanisms of injury in the pediatric patient focusing primarily on the newest data on Traumatic brain injury, abdominal, and cervical spine injury. A brief review of the literature focusing on family presence, the potential hazards of ionizing radiation, and the utility of a Pediatric Trauma center will also be presented. Controversial topics include some recent literature regarding resting after concussion as well as a brief discussion of Massive transfusion protocols will be presented.

The reason for choosing this approach is to first allow the learner to understand what puts a child at risk and how the injury pattern is different from the adult trauma patient. I will review the data from the PECARN head injury, abdominal injury, and cervical trauma series. I will also discuss the National Choosing Wisely initiative and how it relates to the evaluation of the trauma patient.

COURSE OBJECTIVES:

1) Review current literature regarding Pediatric Trauma including Head, Abdominal, and Cervical spine trauma

2) Discuss the different ways that family presence can impact the physiology of the injured patient

3) Address controversies regarding family presence during a resuscitation and how the data shows positive outcomes for not only the patient but also the family.

4) Review, briefly, the literature regarding ionizing radiation and how it pertains to the pediatric patient. In this process, briefly discuss the “Choosing wisely” campaign.

Course Outline:

1) Prevalence of Pediatric Trauma

2) Pediatric Principles—differentiates how pediatric patients differ from adults

3) Traumatic Brain Injury
   a. PECARN
   b. Post-Concussive care – Prolonged rest versus alternative
4) Pediatric Cervical Injury
   a. NEXUS
   b. PECARN
   c. Canadian Cervical spine Rules

5) Traumatic Abdominal Injury
   a. PECARN

6) Massive Transfusion protocol
   a. Brief presentation of Pediatric Trauma Society recommendations

7) Family Centered Care

8 Pediatric Trauma Centers

9) Ionizing radiation update / choosing wisely campaign

References:


Leventhal JM, Thomas SA, Rosenfield NS, Markowitz RI. “Fractures in young children Distinguishing child abuse from unintentional injuries”. *AJDS*, 1993; 147: 87-92


Caffey J. “Multiple Fractures in the long bones of infants suffering from Chronic Subdural Hematoma.” *AJR*. 1946;56; 163-173.


http://www.cdc.gov/traumaticbraininjury/


Dare, AO, Dias MS, and Veetai L. “Magnetic resonance imaging correlation in pediatric spinal cord injury without radiographic abnormality”. *Neurosurgery* 2002;50(3) March supp


Osler, et al.“Do pediatric trauma centers have better survival rates than adult trauma centers? An examination of the National Pediatric Trauma Registry”. *J Trauma*, 2001


“Radiation exposure from CT Scans in Childhood and subsequent risk of Leukemia and Brain Tumours: A Retrospective Cohort Study”. *Lancet* 2012