Pediatric Trauma Care: A Systematic Approach and Review of Complex Cases

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Objectives

• Appreciate pediatric anatomic differences
• Appreciate pediatric physiologic differences
• Have a defined plan of action for:
  – Arrival at scene
  – History and Assessment of injured child
  – Transport to (which)hospital and mode

• Case scenarios: pre- and in-hospital
The Problem

Traumatic injury is the leading cause of death in children
Injury exceeds all other causes of childhood death combined
# 10 Leading Causes of Death by Age Group, United States – 2007

<table>
<thead>
<tr>
<th>Rank</th>
<th>Age Groups</th>
<th>1-4</th>
<th>5-9</th>
<th>10-14</th>
<th>15-24</th>
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*The three causes are: Complicated Pregnancy, HIV, Septicemia.
Source: National Vital Statistics System, National Center for Health Statistics, CDC.
Produced by: Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC.
### National Estimates of the 10 Leading Causes of Nonfatal Injuries Treated in Hospital Emergency Departments, United States – 2008

<table>
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<th>Rank</th>
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<th>10-14</th>
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<td>Unintentional Inhalation/Aspiration 806,819</td>
</tr>
</tbody>
</table>

*The “Other Assault” category includes all assaults that are not classified as sexual assault. It represents the majority of assaults.

Source: NEISS All Injury Program operated by the Consumer Product Safety Commission (CPSC).

Produced by: Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC.
What is a Trauma Center?

• A specialized hospital facility distinguished by immediate availability of personnel and resources to care for injured patients.
VA Designated Trauma Centers
Do All Hospitals Provide Trauma Care?

• Yes, nearly all hospitals perform some degree of trauma care.
• The Trauma Care System is an inclusive system where all acute care hospitals play a part.
• As a Level I Trauma Center, many trauma patients are referred from other area hospitals.
Trauma Centers in VA

• Trauma Centers are *Designated* by the State office of EMS.
• There currently is no separate pediatric trauma designation in VA.
• National *Verification* is achieved through the American College of Surgeons.
• There are currently 14 designated Trauma Centers in VA. Only 3 are verified by the American College of Surgeons.
• One is additionally verified as a Level I Pediatric Trauma Center.
Specialized resources in Pediatric Trauma Centers

• Pediatric Specific:
  – Emergency Medicine, Trauma Surgery, Orthopedics, Neurosurgery, Anesthesia, Radiology, Critical Care medicine, Rehabilitation.
  – Nursing.
  – Social work, Child life, Chaplaincy, Educators,
  – PT, OT, Speech.
Pediatric Trauma

• 10,000 deaths estimated annually
• Majority cared for outside trauma centers
• Relatively infrequent compared to “adult trauma”
• Organized, expeditious transport essential to good outcomes
Injury Severity in Virginia

* ISS values are reported by Trauma Centers only
Development

• Important to understand normal growth and development in your approach to the pediatric patient.
• Try to determine your patient’s “normal”. Are there any cognitive delays?
• Stage of development can be related to types of injuries seen.
Infants

- Infants
- Up to 12 months of age
- May stand or walk
- Follow movements
- Muscle development follows cephalo-caudal progression.
- Allow to remain in caregiver’s lap/arms.
Toddlers

– Age 1-3 years
– Rapid motor development
– May stray from parents
– Parents are the only ones who can comfort them
– Language development
Toddlers

- Approach child slowly
- Examine from head-to-toe
- Avoid asking “yes” or “no” questions
- Allow child to hold blanket or favorite item
- Tell the child if something will hurt.
- Common illnesses include respiratory, febrile and dehydration. Injuries from falls are common while learning how to walk. Prone to accidental ingestions, drowning and abuse.
Preschoolers

• Ages 3-5 years
• Increase in fine and gross motor skills
• Cognitive development
• Seek comfort and support from primary caregiver
• Distorted sense of time
• Fear mutilation
• Illnesses similar to toddlers plus risk of thermal burns and drowning.
• Minimal concept of danger/ self preservation instinct.
School Age

• Ages 6-12 years
• Growth is slower and steadier
• Most bodily functions reach adult levels
• Increased ability to concentrate and learn quickly
• Spending more time with others outside their immediate family.
• Onset of puberty
• Injuries more common from physical activity, bicycle crashes, falls and sports.
Adolescents

- Ages 13-18
- Physical growth and development nearly complete
- Blood chemistry values nearly equal to adult
- Development of secondary sex characteristics
- Personality/identity development
- Parents vs peers
- Sex, drugs and alcohol
- Behavioral emergencies such as depression, suicide, and eating disorders
# Injuries and ages

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Common Injuries</th>
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<tr>
<td>Infant</td>
<td>Abuse, burns, falls, drowning</td>
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<tr>
<td>Toddler</td>
<td>Burns, drowning, falls, poisoning</td>
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<tr>
<td>School-Age</td>
<td>Pedestrian, bicycle, MVC, burns, drowning</td>
</tr>
<tr>
<td>Adolescent</td>
<td>MVC, drowning, burns, intentional trauma, work-related injuries</td>
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</tbody>
</table>
Age distribution of injured children in Virginia 2011-2013
Mechanisms

- Blunt
- Burn
- Penetrating
- Submersion
- Asphyxiation
Mechanism of Injury in VA

- Blunt
- Burn
- Other Injury
- Penetrating

Blunt

- MVC
- Fall
- Bike
- Pedestrian
- Abuse
- Sports and recreation
Burn

- Inhalation Injury
- Thermal
  - scald
- Electrical
- Chemical
- Radiation
Penetrating

- GSW
- Stab
- Impalement
Anatomic Differences: Head/C-spine

• Head relatively large, prone to injury
• Infants have unfused fontanelles; some room to expand
• Cervical spine incompletely ossified; ligamentous injury more common than fracture; upper segment injury more common
Anatomic Differences: Airway

• Large occiput can result in airway obstruction in supine infants- place shoulder roll

• Larynx in general is anterior- can be technically harder to intubate
Anatomic Differences: Chest

• Ribs largely cartilaginous; tend to bend not break. Fracture= large force
• Mediastinum very mobile; can shift one side to the other easily resulting in pneumothorax-tension pneumothorax-cardiac tamponade
• Lungs can absorb significant energy without obvious signs(pulmonary contusion common)
Anatomic Differences: Abdomen

- More protuberant, less shielded by lower ribs; more solid organ exposure
- Arguably thinner abdominal wall; less padding
- No true pelvis until around age 2; contents intrabdominal
- All of above and constant growth a challenge to proper car seat fit and avoiding injury
Anatomic Difference: Skin

• Thinner skin in infants; increased thermal and water loss
• Overall larger surface area to body mass ratio: increased risk for hypothermia from radiant cooling as well as surface contact
 Pediatric Physiologic Differences

• Ability to maintain cardiac output during hypovolemia through increased heart rate
• Ability to maintain blood pressure through vasoconstriction; hypotension then ensues after advanced hypovolemia
• Beware the tachycardic, peripherally cool pediatric trauma patient
Scene Management

- Pediatric Trauma is a high stress event for:
  - Patient
  - Parent
  - Provider

- Initial approach essential as an aid to stress management so patient can be the focus
Scene Management: Patient Approach

- Approach calmly, smiling, direct eye contact
- Calmly introduce yourself; use names
- Explain all you are doing
- Enlist child’s help (can you point to where it hurts)
- Do everything calmly, but move along
Scene Management: Parent Approach

- If appropriate, introduce yourself to parent on way to child
- Calm, methodical, polite
- Enlist parents help (they want to help)
- Don’t separate
- Have parent ride with child (restrained)
Scene Management: Provider Approach

• Take your own advice
• Take your own pulse
• Practice this; it does help
Scene Management: History

- Often done concurrent with introductions to parent and child and with assessment
  - **A** - Allergies
  - **M** - Medicines
  - **P** - Past medical history
  - **L** - last po intake
  - **E** - Events of injury

- Don’t forget weight or estimate!
  - Broselow tape
  - Practice weight based calculations!
• Past Medical History (PMH increases odds trauma is non-accidental
  – Prematurity more common in NAT
• Mechanism (e.g. number of steps; carpeted)
• Hygiene of child, home
• Physical location of injury (>80% NAT occurs at home)
• Any witnesses to injury
Scene Management: Assessment

- The crucial task: is this a sick child?
- Reliably done through “ABC”*
  - Appearance
  - Breathing
  - Circulation

*AAP- Pediatric Education for Prehospital Providers: www.Peppsite.com
Pediatric Trauma: Appearance

- Crying, talking? Assures airway
- Eye contact- an instant picture of condition
  - Interactive gaze reassuring
  - Lack of interaction may be fear, pain, or worse CNS injury or perfusion related (hypotension)
- Obvious injury/fracture?
- Well perfused or pale appearing?
Pediatric Trauma: Breathing

• Respiratory rate
• Easier to detect: Work of breathing
  – Nasal flaring, subcostal retraction in infants
  – Retraction, abdominal breathing in older toddlers/children
• Ask the child calmly if the answer is not obvious
Pediatric Trauma: Circulation

• Appearance (again): pale appearing?
• Peripherally warm or cool? Take in context of ambient temperature
• Capillary refill time
• Pulse
• BP can be tricky in younger children; normal reference values
• Beware the peripherally cool, tachycardic pediatric trauma patient
Utility of “ABC’s”

• An abnormality during assessment of the ABC’s likely indicates a significantly injured child

• Helps with ultimate question of “Is this child sick” as destination and mode of transport are considered
Pediatric Trauma: ABC Examples

• APPEARANCE: lethargic, not talkative but appears well perfused: Consider CNS injury
Pediatric Trauma: ABC Examples

- BREATHING: Increased work of breathing with pain and subcostal flaring, appears completely alert: consider rib fracture/pneumothorax
Pediatric Trauma: ABC Examples

• CIRCULATION: alert, interactive, breathing normal but has abdominal pain. Peripherally cool and tachycardic; cap refill 3 seconds: Consider hypovolemic/abdominal injury
Pediatric Transport: Where to? How?

• Rapidity of transport and transport destination will be determined by your assessment above
• In general, move along at a steady, calm pace but move along
• Know your resources regionally; be prepared to make decision early and communicate
Pediatric Transport: Where to?

- Each case is unique.
- Consider a designated Trauma Center or Pediatric Trauma Center for
  - low GCS, respiratory distress or hypotension;
  - significant injuries such as penetrating or CNS injury
  - significant mechanism (high speed MVA; fall from height)
FIGURE 1. Field triage decision scheme – United States, 2006

Measure vital signs and level of consciousness

Step One

Glasgow Coma Scale: <14
Systolic blood pressure (mmHg): <90 mmHg
Respiratory rate: <10 or >29 breaths per minute
(<20 in infant aged <1 year*)

Yes

Take to a trauma center.† Steps 1 and 2 attempt to identify the most seriously injured patients. These patients should be transported preferentially to the highest level of care within the trauma system.

No

Assess anatomy of injury.

Step Two§

- All penetrating injuries to head, neck, torso, and extremities proximal to elbow and knee
- Flail chest
- Two or more proximal long-bone fractures
- Crushed, degloved, or mangled extremity

Yes

Take to a trauma center. Steps 1 and 2 attempt to identify the most seriously injured patients. These patients should be transported preferentially to the highest level of care within the trauma system.

No

Assess mechanism of injury and evidence of high-energy impact.

- Amputation proximal to wrist and ankle
- Pelvic fractures
- Open or depressed skull fracture
- Paralysis
Step Three

- Falls
  - Adults: >20 feet (one story is equal to 10 feet)
  - Children: >10 feet or two or three times the height of the child
- High-risk auto crash
  - Intrusion*: >12 inches occupant site; >18 inches any site
  - Ejection (partial or complete) from automobile
  - Death in same passenger compartment
  - Vehicle telemetry data consistent with high risk of injury
- Auto vs. pedestrian/bicyclist thrown, run over, or with significant (>20 mph) impact††
- Motorcycle crash >20 mph

Yes

Transport to closest appropriate trauma center, which, depending on the trauma system, need not be the highest level trauma center.§§

No

Assess special patient or system considerations.

Step Four

- Age
  - Older adults**: Risk of injury/death increases after age 55 years
  - Children: Should be triaged preferentially to pediatric-capable trauma centers
- Anticoagulation and bleeding disorders
- Burns
  - Without other trauma mechanism: triage to burn facility***
  - With trauma mechanism: triage to trauma center***
- Time sensitive extremity injury†††
- End-stage renal disease requiring dialysis
- Pregnancy >20 weeks
- EMS§§§ provider judgment

Yes

Contact medical control and consider transport to a trauma center or a specific resource hospital.

No

Transport according to protocol.¶¶¶

When in doubt, transport to a trauma center
Pediatric Trauma Transport

• When in doubt transport to a trauma center
• Significant pediatric trauma should be triaged preferentially to pediatric capable trauma centers

• www.cdc.gov/fieldtriage
Pediatric Transport: How?

• Ground vs Air decision also unique. Consider
  – Specific injury and severity
  – Rural vs urban location
  – Center availability regionally; time taken to get that team to you and back
  – Patient condition

• In general, surgical emergencies excepted, time of transport not tied to outcomes.
Pediatric Trauma: Transport

• Secure child
  – Car seat to stretcher if appropriate (and car seat not damaged)

• Stabilize C-spine and fractures as appropriate

• Oxygen is a vitamin in trauma

• Have parent go with child

• ABC’s : Constantly reassess. Constantly.
Case Scenario #1

• 10 year old male hit a tree with his sled; he does remember the accident
• Initial assessment: c/o right forearm and abdominal pain. Normal respiratory rate.
• Heart rate 125. Hands cold/no gloves. BP 95/55
Case Scenario #1

- Assessment: Blunt trauma patient who is tachycardic with a narrow pulse pressure. Abdominal pain indicates source of hypovolemia to be the abdomen, suggesting organ injury.
- This is a surgical emergency requiring volume replacement and possibly surgery and should go to the nearest trauma capable hospital.
Case scenario #2

- 3 yo fell from second story window onto grass. Initial assessment: crying and holding his head. Normal respiratory assessment and circulation. In preparing for transport, he becomes more somnolent and sleeps, but is arousable.

- You are in a rural area 20 minutes from a community hospital and one hour from a pediatric hospital.
Case Scenario #2

• Assessment: CNS injury. Cervical Spine injury should also be assumed and provided for.

• Given rural location without a pediatric neurosurgeon, it would be reasonable to initiate air transport to a pediatric capable trauma center either from your location or rural hospital depending on location.
Case Scenario #3

- 8 yo in MVC as front seat restrained passenger. Impact his side. c/o right sided chest pain, worse with inspiration. Taking shallow, rapid breaths due to pain. Appears well perfused peripherally. During your assessment his work of breathing increases and he now has shortness of breath.
Case Scenario #3

• Assessment: Chest injury with possible splinting from rib fractures with or without an underlying traumatic pneumothorax.

• Oxygen would be especially useful here given respiratory compromise. Transport should be to nearest trauma capable hospital as a pneumothorax coming under tension is a life threatening emergency that can be treated with a chest tube. Further workup can then continue there.
EMS Call

- 14 mos old male fell down steps and cut his head
- Rural area; recent snow; 30 minute drive
- On arrival, Dad holding child on shoulder
- Dad holding a rag to child’s forehead
- Child softly crying, eyes open
- Dad points to stairs; there are 4
You need to examine the child.
The best way to proceed is:

A. Ask Dad to pass the child to you.
B. Ask Dad to lay the child on the couch.
C. Place an appropriate C-Collar on the child’s neck and then gently take him from Dad.
Examination/Primary Survey

• Airway: open; softly crying intermittently
• Breathing: good breath sounds bilaterally
• Circulation: extremities a bit cool (cap refill 2 secs). Bleeding from forehead controlled
• He cries more when you examine his abdomen.
How will you document his Neurologic status?

A. Glasgow Coma Scale
B. Modified Glasgow Coma Scale
C. AVPU Method
## Modified Glasgow Coma Score for Infants

<table>
<thead>
<tr>
<th>Activity</th>
<th>Best Response</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye Opening</td>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>To Speech</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To Pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Verbal</td>
<td>Coos, Babbles</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Irritable, Cries</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Cries to Pain</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Moans to Pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Motor</td>
<td>Spontaneous movements</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Withdraws to Touch</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Withdraws to Pain</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Abnormal Flexion</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Abnormal Extension</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>
AVPU Method

A = Alert, awake child
V = responsive to Verbal stimuli
P = responsive to Painful stimuli
U = Unresponsive

Advantages are rapidity, ease of assessment and therefore ease in repeating at frequent intervals during transport, with comparison
Examination

• Responds to verbal stimuli but somnolent in between
• BP 85/60. P120. RR 34.
• 4 cm laceration left fronto-parietal area
Is this scenario suspicious for non-accidental trauma?
Age Distribution of Non-Accidental Trauma Under Age 5

<table>
<thead>
<tr>
<th>AGE (months)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>62%</td>
</tr>
<tr>
<td>13-24</td>
<td>19%</td>
</tr>
<tr>
<td>25-36</td>
<td>11%</td>
</tr>
<tr>
<td>37-59</td>
<td>7%</td>
</tr>
</tbody>
</table>

## Non-Accidental Trauma Injury Mortality Under Age 4 years

<table>
<thead>
<tr>
<th>Injury</th>
<th>NAT</th>
<th>Unintentional Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial</td>
<td>42% (O.R. 2.3)</td>
<td>14%</td>
</tr>
<tr>
<td>Thoracic</td>
<td>12% (O.R. 1.7)</td>
<td>4.5%</td>
</tr>
<tr>
<td>Abdominal</td>
<td>11.4% (O.R. 2.7)</td>
<td>6.8%</td>
</tr>
<tr>
<td>PICU</td>
<td>42%</td>
<td>26%</td>
</tr>
<tr>
<td>LOS</td>
<td>9.3%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Survival to Discharge</td>
<td>87%</td>
<td>97%</td>
</tr>
</tbody>
</table>

*DiScala et al, Arch Pediatr Adoles Med, 2000*
What is important to document in this scenario?
• Prior medical history (Odds ratio that trauma is non-accidental: 6.3)
  – Prematurity 7x more common among NAT victims
• Mechanism (e.g. number of steps; carpet)
• Hygiene of child, home
• Physical location of injury (88% of NAT victims injured at home)
• Anyone else at home (witness)
Transport

• Properly restrained, transport begins
• Pre-warmed ambulance
• Community hospital 30 minutes away
• Child now somnolent but responsive to painful stimulus
• 15 minutes in: VS: P85 BP 55/xx
The most appropriate action at this point is:

A. Administer 10cc/kg Lactated Ringer’s and reassess

B. Check pulse oximetry

C. Notify receiving hospital and ask for advice

D. Check the patient’s airway
BLS/ALS/ATLS

- ABC’s
- ATLS based on identifying and treating life threatening issues first
- When things go wrong, start again.
- True for all trauma care provider levels
- Reassess continually!
Alternate Scenario

• Same age, history of trauma, fell down stairs
• Upon arrival, the child is without respiratory effort or pulse.
• Dad reports the child has not moved since the 911 call 30 minutes ago.
• CPR is begun and continued for 20 minutes; no rhythm returns
• Transport is considered; transport time to hospital: 40 minutes
Do Withholding or Termination of Resuscitation Protocols in Pediatric Out Of Hospital Traumatic CardioPulmonary Arrest Exist?
Witholding/TOR for OOHTCPA

• Such protocols exist for ages 18 and older (ACS, AAP and ACEP)
• Majority of states without such protocols for children.
• Providers often at odds with following them
• Resuscitation should proceed if any question exists as to cause or timing of arrest

Fallat, et al, Pediatrics, 2014
If the patient has arrested, resuscitation has already exceeded 30 minutes, and the nearest facility is more than 30 minutes away, involvement of parents and family of these children in the decision-making process with assistance and guidance from medical professionals should be considered as part of an emphasis on family-centered care because the evidence suggests that either death or a poor outcome is inevitable.

Pediatrics 2014;133:e1104–e1116
Joint Position Statement of AAP, ACS, ACEP
At Community Hospital

- Rest of transport uneventful
- NS improved, now GCS 13
- ED evaluation: Head CT with small epidural
- Abdomen tender but not peritoneal; CT deferred due to lack of surgeon
- Transport arranged to tertiary pediatric center 60 miles away
- Your EMS crew has some peds experience; flight crew has more but would need to be dispatched
Which is preferable?

A. An available ground crew with some pediatric experience (60 mins transport)
B. A helicopter crew with lots of pediatric experience but who needs to mobilize (120 mins transport)
There Are No Absolutes

- Specialty pediatric transport teams developed in 70’s/80’s following NICU transport team development
- PROS: specialization, experience, begin therapy during transport
- CONS: expense, waiting around, risk of creating care void if a team is busy
- This makes argument for more broadly experienced teams with regard to availability/expense
- Little evidence time of transport matters, surgical emergencies excepted
Tertiary Pediatric Trauma Center

• On arrival, HD stable
• GCS 13
• Repeat head CT: epidural unchanged
• Abdominal CT: Duodenal hematoma. Grade 4 liver laceration with a blush
Which injury in this child is most suggestive of non-accidental trauma?

A. Epidural hematoma
B. Scalp laceration
C. Liver laceration
D. Duodenal hematoma
Visceral Injuries in NAT

• While all viscera have been reported injured in NAT, Duodenal hematoma in children under 4 highly suggestive of NAT (absent an MVA)
• 80% abdominal injuries without abdominal bruising
• Mortality from NAT 53% vs 21% for unintentional injury

Maguire SA, J Child Abuse Negl 2013
Evaluation and Management of Complex Pediatric Trauma
Case 1

- 11 yo male in night time boating accident
- Sudden deceleration/impact at 35 knots
- Unrestrained in bow of boat; impact R flank/back
- Ejected into water (wearing life jacket)
- Acquisition/Extrication time > 1.5 hours
- HD stable but unresponsive; RSI performed
- Life-Evac flight: 20 minutes
Case 1

- DELTA Pediatric Trauma Team Alert
- On arrival: BP 120/76 P103 RR24 T 37.1
- Intubated, sedated; O2 sats 100%
- Glasgow Coma Scale: 7/15
- What now?
ATLS: Primary Survey

• Airway: Endotracheally intubated. No neck/chest crepitance

• Breathing: Good breath sounds bilaterally, some coarse sounds. Symmetric excursions

• Circulation: BP ok. Extremities cool, not cold. Cap refill- 2 seconds

• Disability: Moves all 4’s; not following commands

• Expose: watch temps!
ATLS: Secondary Survey

• HEENT- PEERL. Abrasions across midface. Laceration over nose
• Neck- C-collar in place. No obvious deformity
• Chest- Right clavicle fx. Ecchymosis below
• Back- Abrasions and ecchymosis across right mid back and flank.
• Abdomen- full but not distended
• Rectal- normal tone. Anterior perineal laceration
Secondary Survey

- Extremities- abrasions across forearms; no bony angulation or ecchymosis
- Vascular-2+ pulses throughout
- Neuro- moves all 4’s. Localizes and withdraws to pain. No commands
Trauma Room Evaluation

- NGT?
- Foley?
- Bloodwork? STBB?
- Xrays?
Trauma Room Evaluation

- Trauma panel sent
- CXR- first!
- CT Head/C- Spine
- CT Chest
- CT Abdomen/Pelvis
- CT Thoracic and Lumbar Spine
- Extremity films
List of Injuries

- **Head**: Diffuse punctate hemorrhages c/w DAI, blood in ventricles, small subdural, cerebral edema
- **Chest**: right 1 and 2 rib fx. Right clavicle fx. Bilateral pulmonary contusions R>L. Aorta nl.
- **Abdomen**: Right posterior lobe liver laceration, right adrenal hematoma, right renal laceration, duodenal/peripancreatic hematoma, no free air
- **Perineum**: Perineal laceration
- **Integument**: diffuse abrasions
Trauma Room Consultations

- Trauma Surgery
- Pediatric Emergency Medicine and Nursing
- Pediatric Trauma Surgery
- Pediatric Anesthesia
- Pediatric Neurosurgery
- Pediatric Orthopaedic Surgery
- Face Service (OMFS, ENT, Plastics)
- Pediatric Critical Care
- Ancillary: Social Work, Pastoral Care
Blunt Abdominal Organ Injuries: Basic Principles

• Absolute Indications for operation: profound hemodynamic instability, hollow viscus (bowel) perforation

• Relative Indications: ongoing blood loss exceeding 40cc/kg; to rule out occult injury

• Absent these, blunt abdominal organ injuries almost always successfully managed non-operatively with close observation in pediatric intensive care environment
Hospital Course

- Non-operative abdominal management undertaken. Vitals, labs, exam watched very closely. Follow up CT 12 hours later reassuring.
- PICU and Neurosurgical support for closed head injury.
- Support of pulmonary contusions
- Patient progressively improved. Extubated. Rehabilitation began
- Additional inpatient services: Pediatric Rehabilitation, PT, OT, Speech Pathology, Pediatric psychiatry
- Transferred to brain injury rehabilitation 18 days after admission
Case #2

• 12 yo male high speed MVA into back of dump truck at 55 mph. Restrained.
• OSH: Hypotensive, agitated. Intubated. Given fluid and 2 u PRBC. Transferred.
• Hypotensive en-route with fluids running
Case #2

- Delta Pediatric Trauma Team Alert
- BP 100/60, P165, RR32
- Saturation 100%
- GCS 6; intermittently combative
- Now what?
ATLS Primary Survey

• Airway: Endotracheal tube in place
• Breathing: good air movement bilaterally
• Circulation: BP now 90/45 P160. Extremities cool.

• Disability-combative.
• Exposure- large seat belt sign across lower abdomen
ATLS-Secondary Survey

- HEENT - Pupils reactive. Abrasions across midface
- Neck - C-collar
- Chest - no obvious trauma
- Abdomen - soft but full and doughy. Prominent seat belt sign with severe bruising. No rectal tone.
- Back - large hematoma over lumbar spine
- Neuro - sedated
Trauma Room Management

- NGT, Foley, IV access
- CXR- wnl; mediastinum ok
- FAST- negative
- HD labile: Is this hypovolemia (trauma) or neurogenic shock along with physiologic stress (neg FAST)
- Options: OR vs CT
CT Abdomen
Operative Findings

• Large hemoperitoneum
• 50% small bowel mesentery avulsed and actively bleeding
• Near transection abdominal wall musculature
• No obvious periaortic hematoma; good distal pulses
Operative Management: Injuries to Consider

- Small bowel avulsion with perforation and contamination
- Abdominal wall transection
- Probable aortic injury
- Spinal cord transection with unstable spine
- Hypotensive, acidemic, likely coagulopathic
Damage Control Laparotomy

- Do only what is necessary to stop bleeding, control contamination and stabilize the patient
- Transfer to ICU environment for resuscitation, warming, treatment of acidosis and coagulopathy
- Return to OR when above are accomplished for definitive management of injuries (24-48 hrs)
Operative Management

- Ligated mesenteric bleeders
- Resected 50% devitalized small bowel and portion of colon
- Stapled bowel ends off
- Inspected retroperitoneum; Doppler of Aorta
- Packed abdominal wall injury
- Closed abdomen with Abthera system
- Underwent 3 more explorations 1st 10 days
Hospital Course

- Prolonged ICU stay
- T10 paraplegia
- Permanent colostomy
- Small pseudoaneurysm of aorta being observed as well as abdominal wall hernia
- Cognitively normal
- Home after rehabilitation stay
Case #3

• 10 yo male fell off bicycle; abdomen landed on handlebar.
• Seen at community hospital; transferred to Level 1 Peds Trauma Center
• CT scan done- without contrast
Case #3
Primary Survey

- Airway patent; talking
- Clear BS bilaterally
- Normal BP; not tachycardic
- No disability
- No other injuries except abrasion on abdomen
Case #3
Secondary Survey

• Remarkable only for tenderness around abrasion; progressed to peritonitis
• U/S obtained concurrently (minimize radiation; avoid CT scan repeat)
• Taken to OR
Summary

- Pediatric trauma is not frequent. Plan ahead.
- Approach in a calm, deliberate manner.
- Assess carefully to determine acuity of injury. Reassess frequently.
- Determine your method and location of transport accordingly.
- Know your regional pediatric trauma resources
Summary

- Pediatric polytrauma benefits from a team approach in a Level 1 Pediatric Trauma Center

- Priorities:
  - Resuscitate via ATLS
  - Define injuries via exam, xray, consultants
  - Operative decision vs observation crucial
  - Immediate access to all of above crucial for best outcomes