Pediatric Aspects of Advanced Trauma Life Support: Transition from EMS to the Trauma Room

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Objectives

1. Identify the critical components of the primary and secondary survey of the Advanced Trauma Life Support process advocated by the American College of Surgeons.

2. Identify unique considerations of injured children and their evaluation.

3. Recognize the important information needed during transfer of patients from EMS to the ED Trauma Room.
Disclaimer

Advanced Trauma Life Support (ATLS) is a training course copyrighted by the American College of Surgeons (ACS).

This lecture does not replace ATLS and is not sponsored by the ACS, but serves to “bridge the gap” between EMS trauma evaluation and ATLS evaluation in the Trauma Room.
Tri-modal Distribution of Death

Tri-modal Distribution of Death

ATLS and Children

JUST LITTLE ADULTS...
ATLS in a nutshell

Primary Survey
  ◦ Assess for and address immediately life-threatening injuries

Secondary Survey
  ◦ Rapid head to toe exam
  ◦ Brief trauma/medical history
  ◦ Adjunctive studies

Tertiary Survey
  ◦ Ongoing assessment for minor or missed injuries
Primary Survey

ABC’s
- Airway
- Breathing
- Circulation
Secondary Survey

Airway
Breathing
Circulation
Disability
Environment/Exposure
Secondary Survey

AMPLE History
- Allergies
- Meds
- PMH/PSH
- Last meal/LMP
- Events of injury
Secondary Survey

Adjunctive studies

- X-rays
- Labs
- CT scans
- Etc.
Tertiary Survey

Ongoing assessment for minor or missed injuries

Occurs about 24 hours after arrival – “after the dust settles”

Continuing process until discharge
ATLS in action

Primary Survey
- Immediately on arrival
- Patient still on transport stretcher
- Performed by Team Leader - most senior doctor present
- Problems with ABC’s addressed as they are identified
- Full report from EMS
- Pause from Team Leader
Secondary Survey
- Patient moved to the ED stretcher
- Full exposure of the patient
- Systematic head to toe exam
- All findings called out by Team Leader
- RN scribe
  - calling back findings to confirm
  - requesting any missing information
- Pause from Team Leader
- Adjunctive studies
Unique Considerations for Injured Children

WHEN CHILDREN REALLY ARE NOT JUST LITTLE ADULTS...
Pediatric Physiology and Hypovolemic Shock

• ↑ CO by ↑HR
  – limited ability to ↑ SV
• Young patients can maintain BP in face of significant blood loss → crash quickly

ATLS Student Course Manual, 2008, Eight Edition, American College of Surgeons Committee on Trauma
# Pediatric Physiology and Hypovolemia

## Table 10-3: Systemic Responses to Blood Loss in Pediatric Patients

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>MILD BLOOD VOLUME LOSS (&lt;30%)</th>
<th>MODERATE BLOOD VOLUME LOSS (30%-45%)</th>
<th>SEVERE BLOOD VOLUME LOSS (&gt;45%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>Increased heart rate; weak, thready peripheral pulses; normal systolic blood pressure (80-90 + 2 x age in years); normal pulse pressure</td>
<td>Markedly increased heart rate; weak, thready central pulses; absent peripheral pulses; low normal systolic blood pressure (70-80 + 2 x age in years); narrowed pulse pressure</td>
<td>Tachycardia followed by bradycardia; very weak or absent central pulses; absent peripheral pulses; hypotension (&lt;70 + 2 x age in years); widened pulse pressure (or undetectable diastolic blood pressure)</td>
</tr>
<tr>
<td>Central Nervous System</td>
<td>Anxious; irritable; confused</td>
<td>Lethargic; dull response to pain(^1)</td>
<td>Comatose</td>
</tr>
<tr>
<td>Skin</td>
<td>Cool, mottled; prolonged capillary refill</td>
<td>Cyanotic; markedly prolonged capillary refill</td>
<td>Pale and cold</td>
</tr>
<tr>
<td>Urine Output(^2)</td>
<td>Low to very low</td>
<td>Minimal</td>
<td>None</td>
</tr>
</tbody>
</table>

\(^1\)The child’s dull response to pain with this degree of blood loss (30%-45%) may be indicated by a decreased response to IV catheter insertion.

\(^2\)After initial decompression by urinary catheter. Low normal is 2 ml/kg/hr (infant), 1.5 ml/kg/hr (younger child), 1 ml/kg/hr (older child), and 0.5 ml/kg/hr (adolescent). IV contrast can falsely elevate urinary output.
Traumatic Arrest

Cardiac arrest most often due to pulmonary arrest

- ADDRESS THE AIRWAY AND BREATHING FAST!

Blunt injury – poor survival

Penetrating injury – modest to good survival
Anatomic Differences

- Stature
- Neurological Development
- Body distribution
  - Surface area
  - Weight
- Musculoskeletal composition
  - Immature growth plates
  - Greater joint laxity
  - More pliable chest wall
Average Multiple Trauma Victim Injuries by body region:

- Head: 59%
- Spine: 2%
- Chest/abdomen: 12%
- Extremities: 26%
Waddell and Drucker’s Triad

1. Fractured Femur
2. Intra-abdominal or Intra-thoracic injury
3. Head injury
Seatbelt Injury Triad

1. Abdominal wall contusion/herniation
2. Chance Fracture
3. Isolated small bowel perforation
A = Airway
Simple to Complex

Suction
Jaw thrust
Oral airway
  • Neonates are obligate nasal breathers
Mask-assisted ventilation
Tracheal intubation
Surgical Airway
Airway
C Spine Support

Manually immobilize the cervical spine when assessing and controlling the airway!

Combined Jaw Thrust
Cervical Spine Immobilization
C-Collar, Backboard, Straps

Assume a c-spine injury unless you know otherwise
B = Breathing
Potential Traumatic Causes
of Impaired Breathing
C = Circulation Assessment

- Heart rate
- Blood pressure
- Central & Peripheral pulses
- Capillary refill
- Skin temperature and color
- CNS perfusion
- Urine output
D = Disability
Glasgow Coma Score

<table>
<thead>
<tr>
<th>Eye Opening</th>
<th>Verbal – Adult</th>
<th>Verbal – Child</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>4=Spontaneous</td>
<td>5=Oriented</td>
<td>5=Smiles, orients to sounds, follows objects, interacts</td>
<td>6=Spontaneous purposeful</td>
</tr>
<tr>
<td>3=To Voice</td>
<td>4=Confused</td>
<td>4=Cries - consolable, inappropriate interactions</td>
<td>5=Localizes pain</td>
</tr>
<tr>
<td>2=To pain</td>
<td>3=Inappropriate</td>
<td>3=Inconsistently inconsolable, moaning</td>
<td>4=Withdraws to pain</td>
</tr>
<tr>
<td>1=None</td>
<td>2=Incomprehensible</td>
<td>2=Inconsolable, agitated</td>
<td>3=Decorticate</td>
</tr>
<tr>
<td></td>
<td>1=None</td>
<td>1=None</td>
<td>2=Decerebrate</td>
</tr>
</tbody>
</table>

GCS = E + V + M
Transition from EMS to ED

IMPROVING CARE AT THE CRITICAL HAND-OFF
Tiered Response

Activation level = Resource level

1. Trauma Consult
2. Partial Trauma Team Activation
3. Full Trauma Team Activation
## ED Trauma Evaluation/Consult

<table>
<thead>
<tr>
<th>AT BEDSIDE</th>
<th>AVAILABLE AS NEEDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedi Surgery Senior Resident/Fellow/NP/PA</td>
<td>ED Charge Nurse</td>
</tr>
<tr>
<td>Pedi Surgery Junior Resident</td>
<td>Radiology Technician</td>
</tr>
<tr>
<td>PEM Attending</td>
<td>Laboratory Technician</td>
</tr>
<tr>
<td>PEM Resident/Fellow</td>
<td>Respiratory Therapist</td>
</tr>
<tr>
<td>ED Nurse x 1</td>
<td>Clinical Social Worker</td>
</tr>
<tr>
<td>Registration</td>
<td>Chaplain</td>
</tr>
<tr>
<td></td>
<td>Other surgical subspecialists</td>
</tr>
</tbody>
</table>
# Partial Trauma Team Activation

## AT BEDSIDE

- Trauma Chief Resident
- Pedi Surgery Senior Resident/Fellow/NP/PA
- Pedi Surgery Junior Resident
- PEM Attending
- PEM Resident/Fellow
- ED Charge Nurse
- ED Nurse x 2
- PICU Charge Nurse/NP
- Radiology Technician
- Laboratory Technician
- Respiratory Therapist

## NOTIFIED/STANDBY

- Registration
- Radiology Resident
- OR notified
- CT on hold
# Full Trauma Team Activation

**AT BEDSIDE**

- Pedi Surgery Attending
- Trauma Attending
- Trauma Chief Resident
- Pedi Surgery Senior Resident/Fellow/NP/PA
- Pedi Surgery Junior Resident
- PEM Attending
- PEM Resident/Fellow
- ED Charge Nurse
- ED Nurse x 2
- Anesthesia Attending/CRNA
- PICU Charge Nurse/NP

- Radiology Technician
- Laboratory Technician
- Respiratory Therapist
- Registration
- Clinical Social Worker
- Chaplain

**NOTIFIED/STANDBY**

- Radiology Resident
- Radiology Attending
- OR on hold
- CT on hold
- PICU Charge Nurse/NP
New Triage Criteria

MATCHING RESOURCES TO THE PATIENT’S NEED
Triage

Better to over-activate than to miss a serious injury

Over-activating leads to excess expense and delays treatment for other patients
New Triage Criteria

Align activation level to likelihood of serious injury

Evidence-based

Bring activation criteria into alignment with the EMS triage rules
<table>
<thead>
<tr>
<th>Level A</th>
<th>Physiology/Anatomy/Injury</th>
</tr>
</thead>
</table>
| AIRWAY/BREATHING | Respiratory Compromise or Obstruction  
  • Intubation in the field /ED  
  • Maxillofacial injuries compromising airway |
| CIRCULATION | • Age-specific hypotension at any time:  
  - <2 years old   < 60 mmHg  
  - 3-5 years old   < 70 mmHg  
  - 6-8 years old   < 80 mmHg  
  - > 8 years old   < 90 mmHg |
| CENTRAL NERVOUS SYSTEM | GCS ≤ 8 with mechanism attributable to trauma |

**Mechanism**

| PENETRATING WOUND | • GSW to head, neck, chest, abdomen, or extremities proximal to the elbow/knee (T-shirt & Boxer Shorts distribution) – Excluding BB wounds  
  • Penetrating neck or chest wounds |
| EXTREMITIES/SKELETAL | • Amputation proximal to wrist or ankle |
| BURNS | • ≥ 40% TBSA second and third degree combined  
  • High voltage electrical injury >600 volts |
<p>| OTHER | • ED attending’s discretion in discussion with Trauma Attending |</p>
<table>
<thead>
<tr>
<th>Level B</th>
<th>Physiology/Anatomy/Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIRCULATION</td>
<td>• Uncontrolled hemorrhage</td>
</tr>
<tr>
<td>CENTRAL NERVOUS SYSTEM, HEAD &amp; SPINE</td>
<td>• GCS 9-12</td>
</tr>
<tr>
<td></td>
<td>• Head or spine injury with focal neurologic deficit</td>
</tr>
<tr>
<td></td>
<td>• Open skull fracture</td>
</tr>
<tr>
<td></td>
<td>• Paralysis</td>
</tr>
<tr>
<td>CHEST</td>
<td>• Chest wall deformity</td>
</tr>
<tr>
<td>ABDOMEN</td>
<td>• Crush injury</td>
</tr>
<tr>
<td></td>
<td>• Pregnancy: 24 weeks by U/S or Fundus at umbilicus + abdominal pain/vaginal bleeding from trauma</td>
</tr>
<tr>
<td>EXTREMITIES/SKELETAL</td>
<td>• 2 or more humerus or femur fractures</td>
</tr>
<tr>
<td></td>
<td>• Unstable pelvis</td>
</tr>
<tr>
<td></td>
<td>• Extremity trauma with neurovascular deficit</td>
</tr>
<tr>
<td>BURNS</td>
<td>• Singed facial or nasal hair</td>
</tr>
<tr>
<td></td>
<td>• Burn in enclosed space and suspected inhalation injury</td>
</tr>
<tr>
<td></td>
<td>• Burn ≥20% TBSA</td>
</tr>
<tr>
<td>Mechanisms (Occult Injury)</td>
<td></td>
</tr>
<tr>
<td>PENETRATING WOUND (Non-GSW)</td>
<td>• Head, abdomen, pelvis, groin (T-shirt, Boxer short distribution)</td>
</tr>
<tr>
<td>FALL</td>
<td>• Fall &gt; 15 feet</td>
</tr>
<tr>
<td>MVC</td>
<td>• Ejection from automobile</td>
</tr>
<tr>
<td><strong>Level C</strong></td>
<td><strong>Anatomy</strong></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>CENTRAL NERVOUS SYSTEM</td>
<td>• GCS 13-14</td>
</tr>
</tbody>
</table>
| NECK/CHEST/ABDOMEN | • Seatbelt Marks with no other Level A or B Criteria  
• Blunt injury with chest, abdomen or pelvic pain or tenderness |

**Mechanisms (Occult Injury)**

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Description</th>
</tr>
</thead>
</table>
| MVC       | High risk crash  
• Intrusion into passenger compartment  
  • >12 inches at the occupant site  
  • >18 inches to any site including roof  
• Death in same passenger compartment |
| MOTOR VEHICLE VERSUS PEDESTRIAN/BICYCLIST | • Thrown or run over  
• >20 mph impact |
| MOTORCYCLE/ATV CRASH | • >20 mph |
| BURNS     | • ≥ 10 TBSA second and third degree  
• <10% TBSA but with circumferential burns  
• > 1% TBSA to face, hands, feet, or perineum |
What we Need to Know to Make This Work
# Information During Call In

<table>
<thead>
<tr>
<th>INITIAL INFORMATION</th>
<th>ADDITIONAL INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, gender</td>
<td>Suspected injuries</td>
</tr>
<tr>
<td>Mechanism</td>
<td>IVF amount</td>
</tr>
<tr>
<td>HR</td>
<td>Meds given</td>
</tr>
<tr>
<td>BP</td>
<td>Response to initial treatments</td>
</tr>
<tr>
<td>RR</td>
<td></td>
</tr>
<tr>
<td>% Sat</td>
<td></td>
</tr>
<tr>
<td>GCS (E, V, M)</td>
<td></td>
</tr>
<tr>
<td>ETA</td>
<td></td>
</tr>
</tbody>
</table>
Information During Call In

Mechanism
- GSW or SW – body region (T-shirt/boxer shorts)
- MVC – Ejection/Intrusion into passenger compartment/Death of passenger
- MCC/ATV – speed
- MV vs Bike/Pedestrian – Separation/Run over/Speed
- Fall – Height (feet)
- Burns – Estimated TBSA 2° & 3°/Face/Hands/Feet/Perineum/Circumferential/Inhalation
- Electrical injuries – Voltage/Type of exposure
What we do with the information
Summary

Injured children benefit from systematic evaluation and management at a pediatric trauma center.

When it comes to trauma, the old adage, “Children are not just little adults” is true.
  ◦ Their different anatomy produces different injury patterns from adults.
  ◦ Their physiologic response to injury is different from adults.

The Glasgow coma scale is effective for children – if slightly modified for the verbal component.

Hasbro Children’s Hospital is making changes to improve the transition from EMS to the Trauma Room.
  ◦ Effective communication is vital to this transition.
  ◦ Collaboration between the EMS providers and the ED staff is central to this communication.
Thank you!
References & Image Credits


http://www.thesharpend.org/blog/2014/7/12/doing-trauma-right-in-the-right-order-at-the-right-time.


https://www2.maricopa.edu/sites/default/files/ER%20simulation.jpg.

http://s3.media.squarespace.com/production/769786/9528765/_LMsvw9l4Jns/SATDjh2UMkl/AAAAAAAAATA/YhDMCHbyo-U/s400/Trauma_Team.jpg.

Slides #22, 23, 26-29. PACTS/PALS Trauma Lecture. Saint Louis University School of Medicine. 2013