Initial Assessment for Pediatric Trauma Patient

Chan Mei Yan
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OBJECTIVES

1. REVIEW differences in anatomy and physiology of the pediatric patient

2. IDENTIFY components of primary and secondary assessment of pediatric trauma patients
Difference in Anatomy and Physiology

Children are NOT simply “little adults”!
Anatomy Differences

- Higher risk of head injury, as the head often “propels forward” in young infants & toddlers
- More leverage on neck and to brain during impacts
- Forces neck into flexion while lying flat
  ~ airway tends to buckle and close on adult spine board without shoulder support

Larger Occiput

- C2-C4 more common injuries
- Trachea is short
  → Increase risk of dislodgement of ETT

Shorter Neck

- 1st 3-6 months of age

Obligate Nose Breathers
Anatomy and Physiology: Pediatric
Anatomy Differences

- Pulmonary contusion more likely
- Diaphragm motion essential for ventilation (Diaphragmatic breathing)
- Energy transmitted to chest organs

Chest wall more pliable
### The Normal Range of Respiratory Rate per PALS*

<table>
<thead>
<tr>
<th>Age (in years)</th>
<th>Breaths/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>30-60</td>
</tr>
<tr>
<td>1-3</td>
<td>24-60</td>
</tr>
<tr>
<td>4-5</td>
<td>22-34</td>
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<tr>
<td>6-12</td>
<td>18-30</td>
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<tr>
<td>13-18</td>
<td>12-16</td>
</tr>
</tbody>
</table>

* Source: American Heart Association, 2010
Abdominal Organs are Less Well Protected

- Liver is not covered by the rib cage
- Less muscle mass to abdominal wall
- Less Sub-Q tissue to absorb the injury
Children are Smaller

- More force per square inch of body
- Organs are closer together → multi-system injury is the rule

Children are Softer (Flexible / Bouncy)

- Bones don’t break but instead pass on energy
- Internal organ damage without fractures is more common

Larger Surface Area to Size Ratio

- Lose heat more rapidly
- Prone to hypothermia

Effects w/Size: Energy Transfer
Metabolic Differences in Kids

Children have a **HIGHER** metabolic rate

- Nearly twice as rapid **O2 consumption**
- Need more **blood flow**
- More frequent **feedings**
- More **fluid intake** per size ratio
Metabolic Differences

Children “shock out” differently

Children compensate better initially
• May show minimal signs and symptoms

Children have less reserves than adults
• Rapid intervention critical
• Once reserves are exhausted → Bad Things Happen...
• Blood pressure is a **POOR INDICATOR** of blood loss and peripheral perfusion

• Children remain in compensated shock **LONGER** than adults, but **DECLINE** very **RAPIDLY**
Early recognition and intervention are CRITICAL!
# The Normal Range of Heart Rate per PALS*

<table>
<thead>
<tr>
<th>Age</th>
<th>HR (Awake)</th>
<th>HR (Asleep)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3 months</td>
<td>85-205</td>
<td>80-160</td>
</tr>
<tr>
<td>3 months - 2 years</td>
<td>100-190</td>
<td>75-160</td>
</tr>
<tr>
<td>2-10 years</td>
<td>60-140</td>
<td>60-90</td>
</tr>
<tr>
<td>&gt; 10 years</td>
<td>60-100</td>
<td>50-90</td>
</tr>
</tbody>
</table>

* Source: American Heart Association, 2010
Assessment is the key for Survival.
Priorities are Similar to Adults

**Primary Assessment/Primary Survey**
- Initial assessment
- Identify potential life-threatening injuries
- ABCDE

**Secondary Assessment/Secondary Survey**
- Re-evaluation of the primary assessment
  - Any signs of deterioration, any further lab & diagnostic tests
- FGHI
Initial Assessment / Management

1. Injury
2. Primary Assessment
3. Resuscitation
4. Reevaluation

Adjuncts

5. Detailed Secondary Assessment
6. Reevaluation
7. Optimize patient status
8. Transfer

Adjuncts
Primary assessment and resuscitation of vital functions are done simultaneously using a TEAM approach.
Primary Assessment

- A: Airway with C-spine protection
- B: Breathing (Oxygenation & Ventilation)
- C: Circulation with Bleeding control
- D: Disability (LOC & pupillary size/reactivity)
- E: Exposure
Primary Assessment

The priorities are the **SAME** for all patients
Airway w/C-Spine Protection

• Assess the child's airway whilst protecting the cervical spine

• A suitable folded pad allows for a child's large occiput and keeps spine in a neutral position

• Immobilisation:
  - Suspected or possible cervical spine injury must have their cervical spine properly immobilised until formal assessment occurs.
Airway w/C-Spine Protection

• How to immobilize the cervical spine?

✓ Apply a one piece hard collar
✓ Ensure appropriate sizing
✓ check sizing of collar in situ
Sizing a one piece hard collar

• Measuring collar size on neck
  – Measure the distance from the top of the patient's shoulder to the angle of the jaw with your hand
Sizing a one piece hard collar

• Checking collar size
  – Measure from the bottom of the rigid plastic to the "measuring post".
  – This should correspond to the above measurement
Sizing a one piece hard collar

- Appropriately fitting collar
Airway w/C-Spine Protection

• Must protect spine
  – Avoid flexing or extending neck
  – Use Jaw-thrust to open airway

• Suspect possible neck injury if:
  – Any injury to head or above clavicles
  – Ejected, thrown, rollover
  – Unconscious trauma case
Basic Airway Techniques

Jaw-thrust Maneuver
Airway w/C-Spine Protection

• Unconscious patients often can’t protect their airway
  – Tongue most common obstruction
  – Little airways are easily blocked by blood, teeth
  – Have rigid suction available (use Yankauer sucker for oral cavity suctioning)
  – Avoid stimulating the gag reflex
  – Jaw thrust to open airway
  – May need oral/nasal airway

• Infants need to breathe through their noses
  – May need to suction out blood/mucus
An Oropharyngeal (Oral) Airway are used in the unconscious victims who do not have a gag reflex.

An OPA should not be used in a conscious or semi-conscious patient because it may stimulate gagging & induce vomiting.

Airway sizes range from 4 to 11 cm in length (Guedel sizes 00 to 6).
Artificial Airway: OPA

PROPER POSITION

1. Placing the oral airway against the side of the face

2. With the flange at the corner of the child’s mouth, the tip of the airway should reach the angle of the jaw
Oropharyngeal Airway Placement

A. Too Long
B. Correct Size
C. Too Long
D. Too Short
Artificial Airway: Nasopharyngeal Airway

- NPA can be used with caution in children who have a **gag reflex** present.
- The **proper airway length** is approximated by the distance from the tip of the nose to the tragus of the ear.
- Nasopharyngeal airway available in **16F to 36F** sizes.
## Artificial Airway: NPA

<table>
<thead>
<tr>
<th>NasoClear Size</th>
<th>ID (mm)</th>
<th>OD (mm)</th>
<th>ID (fr)</th>
<th>OD (fr)</th>
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<tbody>
<tr>
<td>4</td>
<td>4.0</td>
<td>7.0</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>5.0</td>
<td>8.0</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>6.0</td>
<td>9.0</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>7.0</td>
<td>10.0</td>
<td>28</td>
<td>30</td>
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<tr>
<td>8</td>
<td>8.0</td>
<td>11.0</td>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>9</td>
<td>9.0</td>
<td>13.0</td>
<td>36</td>
<td>38</td>
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</table>
Endotracheal Intubation for Trauma Pediatrics

Indications:

- Need for prolonged patency of the airway and/or prevention of aspiration (such as an unconscious child)
- Need for ventilation and/or inability to adequately ventilate using a bag and mask
- Shock unresponsive to fluid resuscitation
- Neurological problems, including seizures and head injury
The mnemonic “**SOAPME**” is one way to remember the essential equipment needed for intubation:

**S: Suction**

- Functioning wall suction
- Appropriate size of suction catheter (FG) that fit into the endotracheal tube = Size of ETT x 2
- Large bore suction catheter / suction device e.g. Yankauer sucker for oro-pharyngeal suctioning
The mnemonic “SOAPME” is one way to remember the essential equipment needed for intubation:

**O**: Oxygen

**A**: Airway

- **Bag-valve-mask (BVM)** of appropriate size for the infant, child or adult
- **Laryngoscope and Blade**: checks that the light is bright enough
## Preparation

<table>
<thead>
<tr>
<th>Age of Patient</th>
<th>Laryngoscope Blade (Size)</th>
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</thead>
<tbody>
<tr>
<td>Term Infant – 6 months (3.5 – 7.5 kg)</td>
<td>0 – 1 straight blade</td>
</tr>
<tr>
<td>1 year (~ 10 kg)</td>
<td>1 straight blade</td>
</tr>
<tr>
<td>2 – 6 years (12 – 20 kg)</td>
<td>2 straight blade</td>
</tr>
<tr>
<td>8 – 10 years (24 – 30 kg)</td>
<td>2 straight or curved blade</td>
</tr>
<tr>
<td>12 years or above</td>
<td>3 straight or curved blade</td>
</tr>
</tbody>
</table>
Preparation

The mnemonic “SOAPME” is one way to remember the essential equipment needed for intubation:

A: Airway

- Endotracheal tube (ETT) of the proper size, preferably one size smaller & larger
- Size of ETT:
  - Length-based resuscitation tape e.g. Broselow tape
  - Age based formula
- Non-cuff ETT is mostly used in infants and young children because of the normal anatomic structure
- Cuffed tubes for children
  - for high risk of aspiration, difficult to maintain sufficient airway pressure during assisted ventilation in a child with poor lung compliance, presence of a large glottic leak
The mnemonic “**SOAPME**” is one way to remember the essential equipment needed for intubation:

**A: Airway**

- **Cuffed ETT (I.D.):**
  - Children 1-2 years of age = 3.5 mm
  - Children 2-10 years = (Age in years ÷ 4) + 3.5

- **Non-cuffed tubes (I.D.):**
  - Children 1-2 years of age = 4.0 mm
  - Children 2-10 years = (Age in years ÷ 4) + 4
  
  [Depth of insertion (cm) = ETT I.D. × 3]

- **Stylet (optional)**
The mnemonic “SOAPME” is one way to remember the essential equipment needed for intubation:

**P: Pharmacology**

- **Midazolam**: Provides sedation and anxiolysis; usually 0.1-0.2mg/kg (adult 5mg) IV
- **Cisatracurium**: Neuromuscular blocker; 0.1-0.15mg/kg
- **Suxamethonium**: Short-term neuromuscular blocker; 2mg/kg IV; IM: double IV dose
- **Morphine**: Narcotic, provides analgesia & sedation; 0.1-0.2mg/kg
Preparation

The mnemonic “**SOAPME**” is one way to remember the essential equipment needed for intubation:

**M: Monitoring**
- ECG, Oximeter, End-tidal CO2 (ETCO2) monitoring

**E: Equipment**
- Personal Protective Equipment (PPE)
- Stethoscope
- Functioning ventilator standby
- Tapes: secure ETT after intubation
- K-Y jelly
- Nasogastric tube for decompressing the stomach
Verification of Tube Placement

- Auscultation: bilateral chest movement \(\rightarrow\) listen for equal breath sounds over both lung fields, especially over the axillae
- Auscultation of the stomach \(\rightarrow\) listen for gastric insufflation sounds over the stomach (it should not be present if the tube is in the trachea)
- Condensation (mist) in the endotracheal tube
- Capnography (End-tidal CO2 monitoring)
- Post-intubation CXR \(\rightarrow\) Distal tip of the ETT preferably 1-2 cm above the carina (~ at the level of 3rd rib and no higher than the 1st rib)

Secure the tube with tape or commercial device
Post Intubation Management

• Initiation of ventilatory support
• Cuff pressure monitoring if cuffed ETT is used
• Place NG/OG tube after ETI if not contraindicated
  – Decompress the stomach
  – Avoid micro-aspiration in mechanically ventilated patients
• Documentation: size of ETT; site (mouth or nose); depth of ETT which mark at lips/teeth/nostril
Breathing

• Airway patency ≠ adequate breathing & ventilation
• Assess and ensure adequate oxygenation and ventilation
  – Respiratory rate, depth & effort
  – Chest movement & expansion
  – Air entry
  – Oxygen saturation
• Inspect for any sign of trauma
• Palpate for any tenderness & pain
Breathing

The **IMMEDIATE** life threatening injuries:

- Tension pneumothorax
- Open pneumothorax
- Cardiac tamponade
- Flail chest and pulmonary contusion
- Massive hemothorax
Breathing

• Give O2 through
  – Nasal cannula
  – Facemask
  – Non-rebreathing mask
• Keep Oxygen saturation > 95%
• For apnoeic or bradypnoeic child → BVM using 100% O2, Intubation & Mechanical ventilation
Circulation

• Assessment included:
  – Heart rate (HR) & Rhythm
  – Pulses (both peripheral & central)
  – Capillary refill time
  – Skin color & Temperature
  – Blood pressure
  – Level of consciousness

• Identification of any hemorrhage site
Circulation

• External bleeding control
  → Applying direct pressure using a sterile pressure dressing

• Intravenous access is a priority
  → Two large-bore catheters; Intraosseous access may be necessary if peripheral access attempts are unsuccessful or central venous cannulation

• Signs of severe hypovolemia or shock, fluid boluses of volume expanders
  → Normal saline or Plasma-lyte, are administered at 20mL/kg

• Hemeorrhagic shock
  → Matched blood or O-negative packed red cells

• Boluses are repeated until perfusion and peripheral pulses improve

• Surgical assessment and intervention may be necessary to control bleeding
Disability

• Assess mental state by determining the child's best response to a painful stimulus, observing his/her posture, and examining the pupillary reflexes.

• Level of consciousness can be quickly determined by AVPU (Alert, responds to Verbal stimuli, responds to Painful stimuli, or Unresponsive).

• Baseline pupillary assessment.

• Changes in level of consciousness → Early indication of decreased oxygenation and perfusion, or significant head injury.

• Signs of ↑ ICP in the child include: Severe headache, emesis, irritability, rapidly deteriorating mental status, abnormal posturing, pupillary abnormalities, and seizures. Infants can demonstrate bulging fontanelle.

• +ve Signs of ↑ ICP → Elective intubated by rapid sequence intubation (RSI).
Exposure

Undress the Patient

Caution

Prevent Hypothermia

Pitfalls

Missed injuries
To prevent hypothermia:

Remove all wet clothing or sheets

Provide warming blanket, and/or a radiant heat source

Active warming by using warmed IV fluids and blood to increase the core temperature
Resuscitation

- Protect and Secure Airway
- Ventilate and Oxygenate
- Stop the Bleeding
- Vigorous Shock Therapy
- Protect from Hypothermia
Adjuncts to Primary Assessment

- ECG
- Urinary Output
- Urinary / Gastric Catheters Unless Contraindicated
- Vital Signs
- ABGs
- Pulse Oximeter and CO2

Primary Assessment
Adjuncts Investigations
Adjuncts Investigations

Diagnostic Tools:

FAST

Fig. 1. Right upper quadrant view depicting a positive FAST scan obtained during the study period with free fluid visible in Morrison’s pouch.
Q.1 The first priority in the primary assessment phase of any pediatric trauma patient is:

A. To immediately establish vascular access.
B. To establish and maintain patency of the airway while maintaining cervical spine immobilization.
C. To obtain immediate x-rays and laboratory studies in order to ascertain the patient's overall status.
D. To alleviate any pain with intravenous analgesics in order to facilitate a more reliable physical examination.
Q.2 Which of the following interventions should be performed first for an unresponsive patient with a suspected spinal cord injury?

A. Head-tilt, chin-lift.
B. Jaw thrust maneuver.
C. Oropharyngeal airway.
D. Nasopharyngeal airway.
Q.3 Life-threatening bleeding should be found and treated during the:

A. Primary assessment.
B. Scene size up.
C. Secondary assessment.
D. Patient history
Q.4 Which of the following is the most frequent cause of airway obstruction?

A. fluid.
B. toys.
C. vomit.
D. the tongue.
Q.5 How should you open the airway of an unresponsive patient with an unknown mechanism of injury?

A. log roll technique
B. jaw-thrust maneuver
C. head tilt–chin lift
D. tongue-jaw lift
What is Secondary Assessment?

The COMPLETE history and physical examination
When do I Start Secondary Assessment?

After

1. Primary assessment is completed
2. ABCDEs are reassessed
3. Vital functions are returning to normal or acceptable
What are the Components of Secondary Assessment?

- **Full Set of Vital Signs**
- **Give Support**
- **Head-to-Toe Assessment; History**
- **Inspect Posterior Surfaces**
• Repeat vital signs are needed until the child is stable.
• Invasive lines, catheters, and/or tubes may be inserted for additional monitoring
• Body Weight:
  – Length-based resuscitation tape e.g. Broselow tape
  – Age based formula
    • Age < 9 yrs: BW (kg) approx. = (2x age) + 9
    • Age > 9 yrs: BW (kg) approx. = 3 x age
  – By asking
F = Family Presence

- Family-centered care
- Support the child during procedures & treatment
- Support services, such as Spiritual Care or Social Services provided to support the family’s spiritual and emotional needs
G= Give Comfort

• Pain and comfort should be addressed
  – Unmanaged pain → \( \uparrow \) oxygen consumption

• Assessing child’s pain using an appropriate pain scale
  – FLACC scale: < 3 years old
  – Wong-Baker FACCES Scale: ≥ 3 years old
  – Numeric scale (0-10): ≥ 9 years old
# FLACC SCALE – (Face, Legs, Activity, Cry, Consolability)

**Instructions:** Rate patient in each of the five measurement categories. Add together to determine total pain score.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FACE</strong></td>
<td>No particular expression or smile, <strong>eye contact</strong> and interest in surroundings</td>
<td>Occasional grimace or frown, withdrawn, disinterested, <strong>worried look to face</strong>, eyebrows lowered, eyes partially closed, cheeks raised, mouth pursed</td>
<td>Frequent to constant frown, clenched jaw, quivering chin, <strong>deep furrows on forehead</strong>, eyes closed, mouth opened, deep lines around nose/lips</td>
</tr>
<tr>
<td><strong>LEGS</strong></td>
<td>Normal position or relaxed</td>
<td>Uneasy, restless, tense, <strong>increased tone, rigidity</strong>, intermittent flexion/extension of limbs</td>
<td>Kicking or legs drawn up, <strong>hypertonicity</strong>, exaggerated flexion/extension of limbs, tremors</td>
</tr>
<tr>
<td><strong>ACTIVITY</strong></td>
<td>Lying quietly, normal position, moves easily and freely</td>
<td>Squirming, shifting back and forth, tense, hesitant to move, guarding, pressure on body part</td>
<td>Arched, rigid, or jerking, <strong>fixed position</strong>, rocking, side to side head movement, rubbing of body part</td>
</tr>
<tr>
<td><strong>CRY</strong></td>
<td><strong>No cry or moan</strong> (awake or asleep)</td>
<td>Moans or whimpers, occasional cries, sighs, occasional complaint</td>
<td>Crying steadily, screams, sobs, moans, <strong>grunts</strong>, frequent complaints</td>
</tr>
<tr>
<td><strong>CONSOLABILITY</strong></td>
<td><strong>Calm</strong>, content, relaxed, does not require consoling</td>
<td>Reassured by occasional touching, hugging, or talking to, distractible</td>
<td>Difficult to console or comfort</td>
</tr>
</tbody>
</table>
Wong-Baker FACES Scale
During secondary assessment, the **DATA** collected during primary assessment **Re-evaluated for any signs of further deterioration**

- **Inspection (Look)**
- **Auscultation (Listen)**
- **Palpation (Feel)**
H: Head-to-Toe Assessment (Head, Face, & Neck)

**Inspection**  Lacerations, depressions, or foreign bodies

**Palpation**  Pain and tenderness  **Ears**  Any blood or CSF

**Eyes**  Pupillary reaction  **Nose**  Any displacement, blood, CSF

**Mouth**  Any injury, including lost teeth & broken dental apparatus

**Neck**  Lacerations, swelling, deformities & jugular vein distention

**Hoarse voice or cough**  Suspicious sign on tracheal trauma or damage to cardiovascular vessels
H: Head-to-Toe Assessment (Chest)

**Inspection**
Symmetry of chest wall movement and expansion, any wound

**Auscultation**
Lung and heart sounds

**Palpation**
Any pain and tenderness

**Assess**
Any pain during respirations, any signs of ↑ respiratory effort such as retractions or nasal flaring
H: Head-to-Toe Assessment (Abdomen)

**Inspection**
Distention, bruising, and lacerations

**Auscultation**
Bowel sounds

**Palpation**
Any pain and tenderness

**Abdominal Girth Measurement**
Monitor for distention
H: Head-to-Toe Assessment (Pelvis & Genitourinary)

**Inspection**
Bruising, lacerations, or blood

**Palpation** Bony prominences of the pelvis should be palpated for pain and instability, which may indicate a fracture

**Genitalia and perineum**
Inspected for signs of trauma and presence of blood

**Urine specimen** Saved & sent for examination
H: Head-to-Toe Assessment (Extremities)

**Inspection & Palpation**

For pain, tenderness, deformities

**Evaluation**

Exam motor function & limb power by evaluating the child’s ability to move fingers and toes, strength of bilateral hand grasps and foot flexion
AMPLE:

A: Allergies
M: Medications
P: Past Illnesses
L: Last Meal
E: Events / Mechanism of injury/ any treatment received before arriving at the hospital
**I= Inspect Posterior Surfaces**

**Logroll Turning**
Spinal cord can be maintained in a neutral position

**Inspection**
Back, flanks, buttocks, and posterior legs for any injury

**Palpation**
Vertebra for any pain or tenderness or instability

**Rectal sphincter** Flaccid → Suspected spinal cord trauma
Q.6 The head-to-toe assessment during the secondary assessment phase is to:

A. Complete the information needed for the chart
B. Re-evaluate the primary assessment
C. Determine resuscitation measures needed
Initial Assessment / Management

1. Injury

2. Primary Assessment

3. Resuscitation

4. Reevaluation

5. Detailed Secondary Assessment

6. Reevaluation

7. Optimize patient status

8. Transfer

Adjuncts
- The End -

THANK YOU

Presented by: Chan Mei Yan