

# Multisystem Trauma

Trauma is the leading cause of morbidity and mortality in children<sup>1</sup>. Children have unique injury patterns and substantial differences in their response to trauma when compared with adults; this requires special consideration when addressing the assessment and management of pediatric trauma. (See [TREKK Multisystem Trauma PedsPac](#) for more details)

## Pediatric Considerations

### ANATOMICAL

- » Small body mass with large surface area, results in increased heat loss and greater external force per body unit area.
- » Proportionally larger and less protected solid organs increase chance of intra-abdominal injury (IAI).
- » Pliable ribcage with less musculature and more mobile mediastinum allows for major thoracic injury without obvious external signs of trauma.
- » Larger head-to-body ratio results in a higher proportion of head injuries and age-related differences in cervical spine injury patterns.

### PHYSIOLOGICAL

- » Higher metabolic rate leads to increased oxygen and glucose demands, increased respiratory rate, and insensible fluid losses.
- » Compensated shock is prevalent and often unrecognized as blood pressure remains normal until child displays rapid decompensation and arrest.

### DEVELOPMENTAL

- » Normal curiosity in young children and increased risk-taking amongst adolescents put children and youth at risk of injury.
- » Children are often fearful with trauma assessments, and providers have difficulty with communication and examination, especially in young, preverbal children.

## Highlights of the Pediatric ATLS Assessment<sup>2</sup>

### AIRWAY WITH CERVICAL SPINE CONTROL

- » Have pediatric equipment available (1/2 size bigger and smaller)
- » Blocks or sandbags with tape across the forehead are better than an ill-fitting cervical collar.

### BREATHING

- » Bag mask ventilation (BVM) with the ability to provide good mask fit, continuous positive airway pressure, and ventilation is a key skill for any provider managing pediatric trauma, and often more valuable than tracheal intubation.
- » Children have short tracheas and are often intubated too deeply; as well, endotracheal tubes are easily dislodged in transport. Secure equipment well.
- » Pulmonary contusions and pneumothoraces can occur even without external or radiological signs of chest wall trauma.
- » Children desaturate quickly. Modified rapid sequence intubation protocols and/or apneic oxygenation may be necessary to avoid hypoxia.
- » Deflating the stomach with a NG/OG tube can improve respiratory status by relieving abdominal distention that impairs breathing. Note: as in adults, a NG tube should be avoided in patients with head trauma.

### CIRCULATION

- » **Beware of tachycardia and signs of peripheral vasoconstriction (delayed capillary refill, cool extremities, thready peripheral pulses) as early signs of shock. DO NOT wait for blood pressure to fall. Compensated shock can quickly lead to rapid decompensation/arrest.**
- » Give **20 mL/kg** warmed isotonic fluids (NS or RL) for signs of shock, **then move to warmed uncrossmatched blood**. If blood is not yet available, and child shows signs of ongoing hemorrhagic shock, then additional 10 mL/kg boluses up to a **total of 40 mL/kg crystalloid** in volume resuscitation may be required. **In children with severe shock and active bleeding, minimize crystalloid and begin transfusing uncrossmatched blood 10-20 ml/kg STAT<sup>2</sup>**. Repeat if further blood products needed, activate local massive hemorrhage protocol if available, and expediate consultation and transfer to definitive care.
- » Note: O-negative blood should be reserved for females and confirmed O-negative patients.
- » Place intraosseous (IO) lines early if intravenous access is difficult (after 90 seconds or 2 attempts at intravenous placement). Consider proximal humeral IOs in hemodynamically unstable patients, especially if concern for intra-abdominal injury (IAI) or hemorrhage.
- » If child requires transfusion, consider administering tranexamic acid if within 3 hours of injury.

### DISABILITY

- » In preverbal children, the [Pediatric Glasgow Coma Scale](#) is an accurate tool to assess and communicate mental status after trauma.
- » Check blood glucose in infants and young children to ensure hypoglycemia is not contributing to altered mental status.
- » Address pain (with appropriate analgesia) and distress (with family presence, distraction techniques, and calm person at head of bed).

## EXPOSURE

- » Keeping children warm after trauma is of critical importance. Methods include warm blankets, overhead heaters, forced air warmers (e.g. Bair Hugger®), and warmed intravenous fluids (+/- blood).

## FAMILY PRESENCE

- » Option for family presence is **standard of care** in pediatric trauma centers across North America; must have a dedicated and trained support person to remain with family if they choose to be present for the resuscitation.
- » Current evidence demonstrates reduced stress on the family and patient without compromising medical care or team dynamics.
- » Communication between the medical team, patient and family is often enhanced.
- » The suitability of family presence should be assessed based on the family's preference, the availability of a support person, and the potential for exposure to invasive/distressing medical interventions. Continue to check-in with family members to ensure they are still able to remain in the resuscitation room.

## Diagnostic imaging for pediatric multiple trauma

- » Standard pediatric trauma films after blunt trauma include chest, pelvic and cervical spine radiography prior to transport.
- » For children whose cervical spines cannot be clinically cleared, a referring center should maintain the child in proper cervical immobilization and either forego imaging or use radiography as a screening tool. CT imaging of the neck is NOT routine or warranted for all pediatric trauma patients, and is best done at a pediatric trauma center.
- » Screening radiography in children less than 8 years is 2 views of the neck (AP and lateral); odontoid view is added in children 8 years or older.
- » Pelvic x-rays can be omitted in children at low risk for fracture with a normal GCS and hemodynamic status and **NONE** of the following:
  - » Signs of abdominal trauma
  - » Abnormalities on examination of pelvis
  - » An associated femur fracture
  - » Hematuria

## BOTTOM LINE FOR RADIOGRAPHY OF BLUNT PEDIATRIC TRAUMA PRIOR TO TRANSPORT

- » **Chest x-ray:** Yes
- » **Cervical spine x-rays:** May be done if unable to clinically clear, or may be deferred if child is left in cervical collar for transport.
- » **Pelvic x-rays:** Yes, if concern for pelvic fracture or hemodynamic instability.
- » **CT Imaging:** Should NOT delay transport; usually best decision is to allow pediatric trauma center to perform CT imaging.

## EFAST (EXTENDED FOCUSED ASSESSMENT WITH SONOGRAPHY IN TRAUMA) IN CHILDREN

- » Currently, FAST scans have limited sensitivity, and while helpful if positive, **are not adequate to rule out** intra-abdominal injury (IAI).
- » Use of FAST in combination with clinical factors such as physical exam, laboratory tests, and serial assessments increases sensitivity of the exam, and future pediatric trauma guidelines may incorporate this clinical strategy.
- » Extended component of EFAST includes evaluation for pneumothorax, hemothorax and long bone fractures. Thoracic point of care ultrasound with an adequately trained user is sensitive for detecting pneumothorax and hemothorax.
- » If concern exists for clinically important IAI, abdominal CT scan is necessary and best obtained at a pediatric trauma centre.

## Transport considerations and checklist (See [TREKK Transport Checklist](#) for more details)

- » Life-threatening injuries identified and addressed
- » Early communication with receiving center established
- » Ongoing analgesia, sedation +/- paralysis plan as needed
- » Analgesia addressed, fractures splinted, antibiotics for open fractures
- » If pneumothorax is identified, a chest tube may need to be placed prior to land transport; should definitely be placed for air transport.
- » Communication of key clinical information including patient status, weight (can be estimated with Broselow tape), age, identified injuries, interventions performed, and estimated time of arrival.
- » IV or IO access in place and stabilized
- » Airway controlled & equipment well-secured
- » Gastric tubes & urinary catheters secured as needed
- » Imaging, lab results & paperwork available to crew

**The purpose of this document is to provide healthcare professionals with key facts and recommendations for the diagnosis and treatment of multisystem trauma in children in the emergency department.** This summary was produced by the multisystem trauma content advisor for the TREKK Network, Dr. Suzanne Beno of the Hospital for Sick Children, and uses the best available knowledge at the time of publication. However, healthcare professionals should continue to use their own judgment and take into consideration context, resources and other relevant factors. The TREKK Network is not liable for any damages, claims, liabilities, costs or obligations arising from the use of this document including loss or damages arising from any claims made by a third party. The TREKK Network also assumes no responsibility or liability for changes made to this document without its consent. This summary is based on:

1. Yanchar NL, Warda LJ, Fuselli P; Canadian Pediatric Society Injury Prevention Committee. [Child and youth injury prevention; a public health approach](#). Paediatr Child Health 2012;17(9): 511
2. ATLS Subcommittee; American College of Surgeons' Committee on Trauma; International ATLS working group. [Advanced trauma life support \(ATLS®\): the tenth edition](#). 2018. 78-0-9968262-3-5
3. Kenefake ME, Swarm M, Walthall J. [Nuances in Pediatric Trauma](#). Emerg Med Clin N Am 31 (2013) 627-652.
4. Mikrogianakis A, Grant V. [The Kids Are Alright: Pediatric Trauma Pearls](#). Emerg Med Clin North Am. 2018 Feb;36(1):237-257