



BOTTOM LINE RECOMMENDATIONS:

Multisystem Trauma

Trauma is the leading cause of morbidity and mortality in children¹. 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.

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 & examination, especially in young, preverbal children.

PEDIATRIC ATLS ASSESSMENT (KEY POINTS FOR PRIMARY SURVEY IN CHILDREN)

AIRWAY WITH CERVICAL SPINE CONTROL

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

BREATHING

- » Children have short tracheas & 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 and modified rapid sequence intubation protocols may be necessary to avoid hypoxia.
- » Deflating the stomach with an NG/OG tube can improve respiratory status by relieving abdominal distention that impairs breathing.

CIRCULATION

- » Be wary of tachycardia and signs of peripheral vasoconstriction (delayed capillary refill, cool extremities, thready peripheral pulses).
- » **DO NOT wait for blood pressure to fall.** Compensated shock can quickly lead to rapid decompensation & arrest.
- » Warmed isotonic fluids (NS or LR) should be administered at bolus doses of **10 or 20 ml/kg** based on severity of shock or presence of active bleeding. Between **10 – 40 ml/kg** preparation for giving blood products should occur if hemodynamic status remains compromised. In children with severe shock and active bleeding, minimize crystalloid and begin transfusing uncrossmatched blood (ideally group O-) ASAP.
- » Place intraosseous lines early if intravenous access difficult (after 90 seconds or 2 attempts at intravenous placement).

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 an altered mental status.
- » Address pain (appropriate analgesia) and distress (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

- » Standard in pediatric trauma centers across North America; must have dedicated personnel to remain with family.
- » Evidence demonstrates reduced stress on the family and patient without compromising medical care or team dynamics.
- » Communication between the medical team and the family is enhanced.

DIAGNOSTIC IMAGING FOR PEDIATRIC MULTIPLE TRAUMA

- » ATLS 9th Edition recommends chest and pelvic radiography after blunt trauma prior to transport.
- » CT imaging of the neck is **NOT** routine or warranted for all pediatric trauma patients, and is best done at a pediatric trauma center.
- » For children whose cervical spines cannot be clinically cleared, a referring center may either maintain the child in proper cervical immobilization & forego imaging, or use radiography as a screening tool.
- » Screening radiography in children <8 years is 2 views of the neck (AP and lateral); odontoid view recommended in children ≥ 8 years.
- » 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 pelvic exam, an associated femur fracture, or 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 suspicion of pelvic fracture or hemodynamic instability.
- » **CT Imaging:** Should **NOT** delay transport; usually best decision is to allow pediatric trauma center to perform CT imaging.

FAST IN CHILDREN

- » Currently, FAST scans have limited sensitivity on their own, and while helpful if positive, **are not adequate to rule out IAI**. Abdominal CT scan is currently necessary and best obtained at a pediatric trauma centre if concern exists for clinically important IAI.

PEDIATRIC TRAUMA SCORE

- » Trauma triage scores have been developed to predict which children require trauma center-level care.
- » The [Pediatric Trauma Score \(PTS\)](#) was developed to reflect children's vulnerability to traumatic injury, emphasizing the importance of the child's weight and airway.
- » Several studies have confirmed that the PTS is a valid tool in predicting mortality of a traumatically injured child.
- » As a guide, the score recommends that all children with a PTS < 8 (i.e. any child that is high risk or worrisome) should be transferred to a pediatric trauma center. Local resources and consultation with a pediatric trauma center early will help with transport and referral decision.

TRANSPORT CONSIDERATIONS AND CHECKLIST

- » Life-threatening injuries identified and addressed
- » Early communication with receiving center established
- » Ongoing sedation +/- paralysis plan as needed
- » Analgesia addressed, fractures splinted, antibiotics for open fractures
- » 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
- » If pneumothorax is identified, a chest tube may need to be placed prior to transport; should definitely be placed for air transport.
- » If child requires transfusion, consider administering tranexamic acid (TXA) if within 3 hours of injury. Initial dose for < 12 years is 15 mg/kg (max 1g), and for ≥ 12 years is 1g.
- » Communication of key clinical information including patient status, weight (can be estimated with Broselow tape), age, identified injuries & interventions and estimated time of arrival.

MAJOR CAUSES OF INADEQUATE RESUSCITATION IN CHILDREN

1. Failure to support airway and breathing (compromise of oxygenation and ventilation is common).
2. Failure to recognize and respond to intra-abdominal hemorrhage (loss of perfusion is less common but potentially lethal).
3. Failure to adequately address cardiopulmonary resuscitation (points 1 and 2) in children with traumatic brain injury; this is the leading contribution to secondary brain injury.

The purpose of this document is to provide health care 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 ninth edition](#). J Trauma Acute Care Surg. 2013 May;74(5):1363-6.
3. Kenefake ME, Swarm M, Walthall J. [Nuances in Pediatric Trauma](#). Emerg Med Clin N Am 31 (2013) 627-652.

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