

Joint Trauma System



Pediatric Trauma



Joint Trauma System Battlefield Trauma Educational Program



EWS Pediatric Trauma Scenario



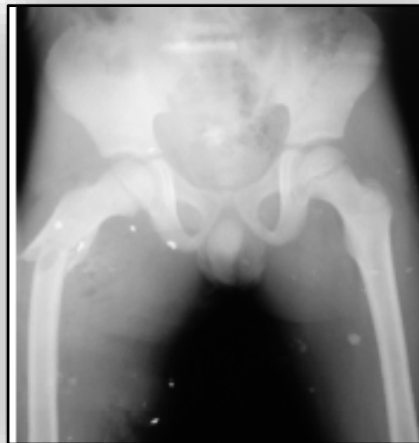
A 3-year-old male is thrown 10 feet by an explosion in a nearby building. He has multiple punctate shrapnel wounds to the extremities and chest and has altered mental status.

What are the anatomic and physiologic differences between children and adults that will affect their care?

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Learning Objectives

- Pediatric resuscitation
- Anatomic and physiologic considerations of pediatric patients



5-year-old Iraqi male injured in a blast

Source: War Surgery in Afghanistan and Iraq, Borden Institute

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Initial Trauma Evaluation

- Systemic evaluation follows adult assessment algorithms (i.e. ATLS)
- Resuscitation and vital signs can vary significantly with age and are often estimated using weight-based or length-based nomograms.
 - Broselow Pediatric Emergency Tape helpful adjunct in resuscitation

Age	Weight (kg)	Respiratory Rate	Pulse	BP(Systolic)
Premie	<3	40-60	130-150	42 ± 10
Term	3	40	120-140	60 ± 10
1-5 years	-10-20	20-30	100-130	95 ± 30
6-10 years	20-32	12-25	75-100	100 ± 15
Adolescent	50	12-18	70	120 ± 20

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Airway Management



Establishing a definitive airway is also based on age and weight

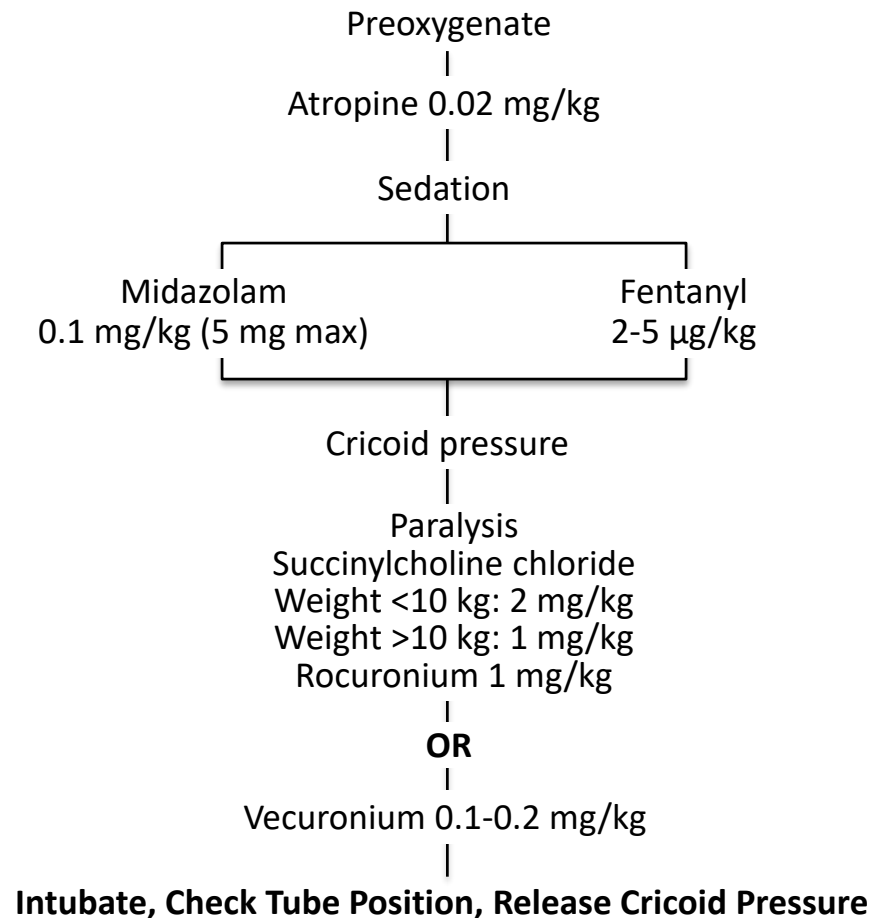
Age, weight (kg)	Airway/Breathing						Circulation		Supplemental Equipment				
	O ₂ Mask	Oral Airway	Bag Valve	Laryngoscope	ET Tube	Stylet	Suction	BP Cuff	Peripheral IV	NG Tube	Chest Tube	Urinary Cath	C-Collar
Premie 3 kg	Premie Newborn	Infant	Infant	0 Straight	2.5-3.0 No cuff	6 Fr	6-8 Fr	Premie Newborn	24 gauge	12 Fr	10-14 Fr	5 Fr Feeding	—
0-6 mo 3.5 kg	Newborn	Infant Small	Infant	1 Straight	3.0-3.5 No cuff	6 Fr	8 Fr	Newborn Infant	22 gauge	12 Fr	12-18 Fr	5-8 Fr Feeding	—
6-12 mo 7 kg	Pediatric	Small	Pediatric	1 Straight	3.5-4.0 No cuff	6 Fr	8-10 Fr	Infant Child	22 gauge	12 Fr	14-20 Fr	8 Fr	Small
1-3 yrs 10-12 kg	Pediatric	Small	Pediatric	1 Straight	4.0-4.5 No cuff	6 Fr	10 Fr	Child	20-22 gauge	12 Fr	14-24 Fr	10 Fr	Small
4-7 yrs 16-18 kg	Pediatric	Medium	Pediatric	2 Straight or curved	5.0-5.5 No cuff	14 Fr	14 Fr	Child	20 gauge	12 Fr	20-32 Fr	10-12 Fr	Small
8-10 yrs 24-30 kg	Adult	Medium Large	Pediatric Adult	2-5 Straight or curved	5.5-6.5 Cuffed	14 Fr	14 Fr	Child Adult	18-20 gauge	12 Fr	28-38 Fr	12 Fr	Medium

BP: blood pressure; Cath: catheter; C-collar: cervical collar; ET: endotracheal; Fr: French (gauge); IV: intravenous; NG: nasogastric; O₂: oxygen

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Establishing an Airway

- Unlike adults, pediatric patients require atropine to avoid bradycardia with intubation
- Apply the algorithm (at right) for rapid sequence intubation of the pediatric patient



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Surgical Airway

- Under age 10, Needle Cricothyroidotomy should be performed
 - ❑ Performed using a large-bore IV (16-18G) with angiocath connected to high-flow oxygen
 - ❑ Allows for ~45 min of oxygenation before hypercarbia becomes an issue
 - ❑ Standard surgical cricothyroidotomy can cause severe laryngeal damage
- Tracheostomy procedure is same as for adults.



A different 5 year old Iraqi male with a penetrating mandible injury.

Source: War Surgery in Afghanistan and Iraq, Borden Institute

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Pulmonary Issues



- Most common cause of cardiac arrest is respiratory arrest.
- Anatomically, a child's larynx is more anterior, making intubation more difficult.
 - May require positioning with a towel or other object under the child's shoulders. The goal is to extend the head not flex it.
- Newborns tend to be obligate nasal breathers; frequent nasal suctioning or nasopharyngeal airways can be effective interventions to alleviate airway obstruction.
- Infants breathe with their diaphragm and problems that limit diaphragmatic movement can impede breathing.

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- Neurologic deficits can be difficult based on the child's age. A modified Glasgow Coma Scale for children < 4 years of age is required.

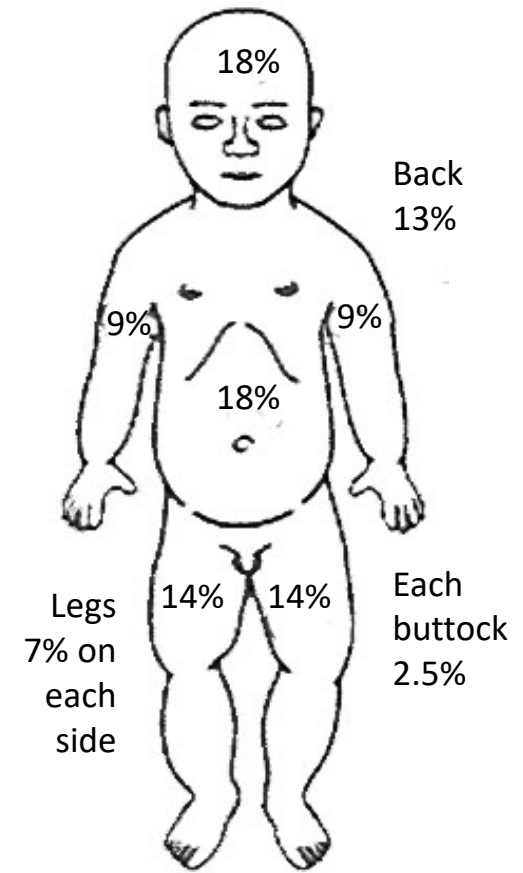
<u>Verbal Response</u>	<u>Verbal Score</u>
Appropriate words / social media / fixes / follows	5
Cries but consolable	4
Persistently irritable	3
Restless, agitated	2
None	1

- Cervical spine can be clinically cleared, but those that are obtunded, those with neurologic deficits, and those with tenderness require imaging as available.
- CT imaging is a useful tool, but try to limit radiation dose if possible.
- In children under 10 kg, contrast should be injected by hand.

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Rules of 9

- Child anatomy makes using the rules of 9 problematic the younger the patient.
- The area of the hand represented by the palm and fingers can represent 1% of the body surface.



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Nutrition

Occasionally, long term care is required for pediatric patients within the military trauma system

- Nutrition – 120 kcal/kg/d
 - At least 2 g/kg of protein from birth to 12 years old
 - Breast milk is always first choice for infants
- Hourly fluid requirements are weight based and should include dextrose and potassium due to the predisposition toward hypoglycemia and sensitivity to electrolyte imbalances.

Weight (kg)	Hourly Volume	Fluid
Up to 10 kg	4 mL/kg	D5¼ NS + 20 mEq KCl/L
11-20 kg	40 mL + 2 mL/kg over 10 kg	D5¼ NS + 20 mEq KCl/L
>20 kg	60 mL + 1 mL/kg over 20 kg	D5¼ NS + 20 mEq KCl/L

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Infant Surgery



- Infant Surgical Approach
 - ❑ Transverse incisions should be used.
 - Reduces risk of postoperative dehiscence.
 - Allows adequate surgical exposure.
 - ❑ Absorbable suture such as Vicryl or PDS (2-0) should be used to close rectus fascia regardless of incision.
 - ❑ Skin can be closed with staples or absorbable monofilament.
- If pediatric surgical set not immediately available, a peripheral vascular set will usually contain instruments delicate enough.
- Majority of thoracic injuries can be managed with a chest tube alone.
 - ❑ Resuscitative thoracotomy feasible in penetrating trauma
 - ❑ Contraindicated in blunt trauma – survival profoundly low in children

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Exercise



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References



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