

Pediatric Trauma

Dr. Frederick Lloyd

Palo Alto Medical Foundation

Palo Alto, California

Objectives

- Describe unique anatomic and physiologic characteristics of children
- Define the concepts of primary and secondary surveys
- Discuss the identification and initial management of life-threatening injuries in the major organ systems: head and neck, chest, abdomen

Epidemiology

- Leading cause of death in children in North America
- 1.5 million injuries
- 250,000 hospitalizations
- 100,000 permanently disabled

Mechanism of Injury

- 87% blunt trauma
- Motor vehicle injuries and falls are the most common
- Vietnam
 - ~ 12,000 motor vehicle accidents per year
 - ~ 13,000 injuries
 - ~ 3,900 deaths

Children are Different

- Smaller body size
- Greater relative body surface area
- Internal organs are more anterior and protected by less subcutaneous fat
- Differences in the pediatric airway
- Cervical spine differences
- Head to toe body ratio greater

Children are Different

- Presence of physes- Salter-Harris fractures
- Greater distribution of force to a child resulting in multiple trauma
- Greater airway resistance and smaller more anterior airway makes airway management more difficult and the need for it more likely

Children are Different

- Greater head to body ratio making head injury more common
- Greater relative body surface area makes heat loss more clinically significant

Children are Different

- A child's blood pressure may be maintained with up to 30% acute blood loss
 - Greater capacity to compensate by increasing heart rate and systemic vascular resistance
- Internal organs are more anterior making liver and spleen injuries more common

Approach to trauma management

- Organized approach and preparation
- Primary survey: assess life or limb threatening problems first
- Flow of care determined by A-B-C-D-E-F
- Team response

Primary Survey

- A: airway and cervical spine precautions
- B: breathing and treatment of life threatening chest injuries
- C: circulation with external hemorrhage control
- D: disability and neurologic screening
- E: exposure and thorough exam
 - *Should be completed in 5 minutes*

Airway

- Open airway using jaw thrust maneuver and maintain spinal precautions as needed
- Use suction to remove secretions, blood, and vomitus

Breathing

- Assess respiratory rate, effort and chest wall rise
- Assess adequacy of minute ventilation
 - Minute ventilation = tidal volume X resp rate

Breathing: Possible Interventions

- Supplemental oxygen
- Bag valve mask ventilation
- Endotracheal intubation

Indications for Endotracheal Intubation

- Inability to ventilate child by bag valve mask or need for prolonged airway management
- Respiratory failure
- Neurologic resuscitation
- Shock unresponsive to volume resuscitation

Recognize and Treat Any Life Threatening Chest Injuries

- Tension pneumothorax
- Cardiac tamponade

Circulation

- Recognize compensated shock
- Management priorities include stopping source of blood loss and restoration of circulating volume

Trauma Related Shock

- Hypovolemia – hemorrhage, burns
- Cardiogenic – myocardial contusion
- Obstructive – hemothorax or pneumothorax
- Distributive / Neurogenic – spinal cord injury

Circulation Assessment

- Heart rate
- Peripheral pulses
- Capillary refill time
- Blood pressure
- Precordial exam
- External bleeding

Signs of Shock

- Tachycardia
- Decreased mentation
- Abnormal skin findings
- Narrowed pulse pressure
- Decreased urine output
- Hypotension

Management of Shock

- Stop external bleeding
- Administer fluid resuscitation
 - Normal saline at 20 ml/kg repeat as needed
 - Packed RBCs at 10 ml/kg
- Surgery if condition remains unstable after fluid resuscitation

Intravenous access

- Peripheral IV
- Central line
- Intraosseus
- Venous cutdown

Laboratory Evaluation

- Priority: type and crossmatch
- Critical injury: complete cell count, electrolytes, renal function tests, glucose, prothrombin time (PT), partial thromboplastin time (PTT), type and crossmatch, urinalysis, amylase
- Minor injury: only as indicated, consider hemoglobin and urinalysis

Radiography

- Critical injury
 - chest radiography
 - Anteroposterior view of pelvis
 - CT of head and abdomen
 - Cervical spine series
- Minor injury
 - Only as indicated

Disability – Neurologic Screening

- Pupillary response
- Level of consciousness
- Glasgow Coma Score (GCS)
- Obvious localizing signs
- Assess neuro status before and after interventions

Glascow Coma Score

- Eye opening response
 - SPONTANEOUS = 4
 - TO SPEECH = 3
 - TO PAIN = 2
 - NONE = 1

Glascow Coma Score

- Verbal
 - ORIENTED = 5
 - CONFUSED CONVERSATION = 4
 - INAPPROPRIATE WORDS = 3
 - INCOMPREHENSIBLE SOUNDS = 2
 - NONE = 1

Glascow Coma Score

- Upper limb motor response
 - OBEYS COMMANDS = 6
 - VOCALIZES = 5
 - WITHDRAWS = 4
 - ABNORMAL FLEXION = 3
 - EXTENSOR RESPONSE = 2
 - NONE = 1

Suspect Cervical Injury

- Head, neck or face injury
 - Neck pain or neurologic symptoms at any time
 - Altered level of consciousness or presence of distraction on injury (fracture)
 - Mechanism of injury

Exposure

- A complete body check for signs of other injury
- Maintain modesty
- Maintain body temperature
- Look for signs of child abuse

Further Interventions

- Insert naso or orogastric tube
- Insert urinary catheter if needed after examination of rectum and perineum

Reassessment

- Secondary survey
 - History: A-M-P-L-E
 - Complete examination
- Additional radiographic and laboratory studies
- Problem identification

Family

- Family members often feel guilty regardless of actual involvement in injury
- Keep family informed
- Allow parent to be with child as much as possible

Psychosocial Issues for Pediatric Trauma Patients

- Fear of strange faces
- Separation anxiety
- Poor understanding of injuries
- Loss of function or to appear “different”
- Pain – *Please treat pain adequately*

Disposition

- Know local capability, resources and transfer policies
 - Critically injured children fare better in a pediatric ICU than in an adult ICU
 - Documentation and communication are vital to the continuity of care

Key Points to Remember

- Primary Survey A – B – C – D – E – F
- Assessments and interventions can happen simultaneously when working as a team
- Frequently reassess patient
- Obtain consultation early if available
- Keep family and patient informed

Burn Slides

Epidemiology

- Thermal burns are the 2nd most common cause of traumatic pediatric deaths in the USA
- Most occur in the home
- Scalding injuries most common in children under 3 years of age

Electric Injuries

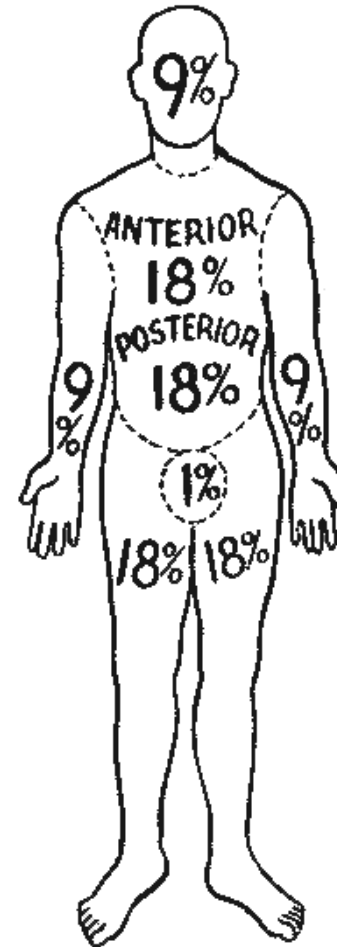
- Electric burns account for ~5% of burn unit admissions
 - 1300 deaths
 - 5200 nonfatal injuries
- Pediatrics account for ~ 1/3 of these

Classification: Depth

	Depth	Blisters?	Texture and color?	Pain?
1 st degree	Superficial	No blisters	Local erythema	Pain
2 nd degree	Partial thickness	Blisters	Mottled or red skin, moist	Pain
3 rd degree	Full thickness	No blisters	Pale, white or black skin, dry	No pain

Classification: Extent

- Only partial and full thickness burns are included in calculations
- Rule of 9s



Classification

- For children under 9, use the Lund and Browder chart or estimate by assuming that a child's palm = 1% of body surface area

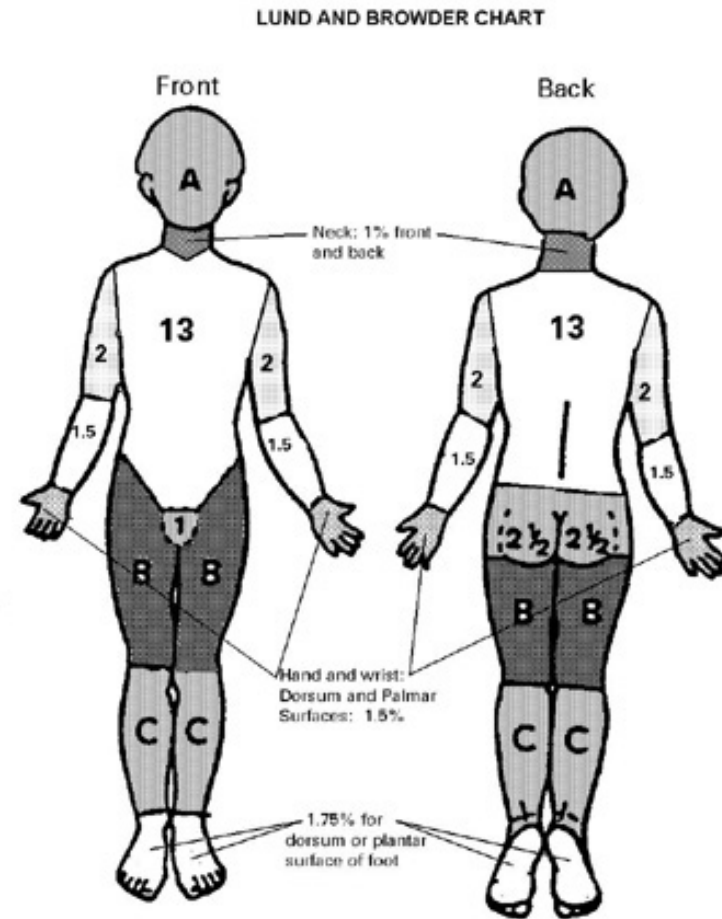


DIAGRAM AREA	AGE IN YEARS			
	0	1	5	10
A = 1/2 of Head	9.5	8.5	8.5	5.5
B = 1/2 of Thigh	2.75	3.25	4	4.25
C = 1/2 of Leg	2.5	2.5	2.75	3

Classification

- Major burn > 15-20% total body surface area
- Other important burns in children:
 - Face
 - Hands
 - Perineum

Initial Assessment and Management

- ABCs

Indicators of inhalation injuries

- Cyanosis
- Black sputum
- Oropharyngeal injury
- Hoarse voice cough
- Facial burns
- History of closed space confinement
- Decreased level of consciousness

Intubate these patients early

Initial Assessment and Management

- Vascular access and fluid resuscitation
 - Start for burns greater than 10% BSA
 - Use normal saline or lactated Ringers
 - $3 - 4 \text{ ml.kg body weight} \times \% \text{ TBSA burned}$
 - Half over the first 4-8 hours and half over next 16-20 hours
 - Don't forget maintenance fluid (dextrose) divided over 5 hours

Initial Assessment and Management

- Monitor urine output to maintain > 1 ml/kg/hr
- Complete blood count
- Electrolytes
- Renal function
- Urinalysis
- Administer tetanus prophylaxis and analgesia
- Consider nasogastric tube

Wound care

- Cool compresses only if $< 10\%$
- Wash with warm water or saline
- Debride only dead skin, leave blisters intact
- Apply antimicrobial agent (silver sulfadiazine)

Wound Care

- Cover with non-adherent dressing or leave open
- Escharotomy for constricting circumferential burns
- Reassess daily

Complications

- 1st hour: respiratory compromise
- Hours: burn shock
- Days: renal failure
- Days to weeks: infection, tetanus, iatrogenic
- Other: vascular compromise, ileus