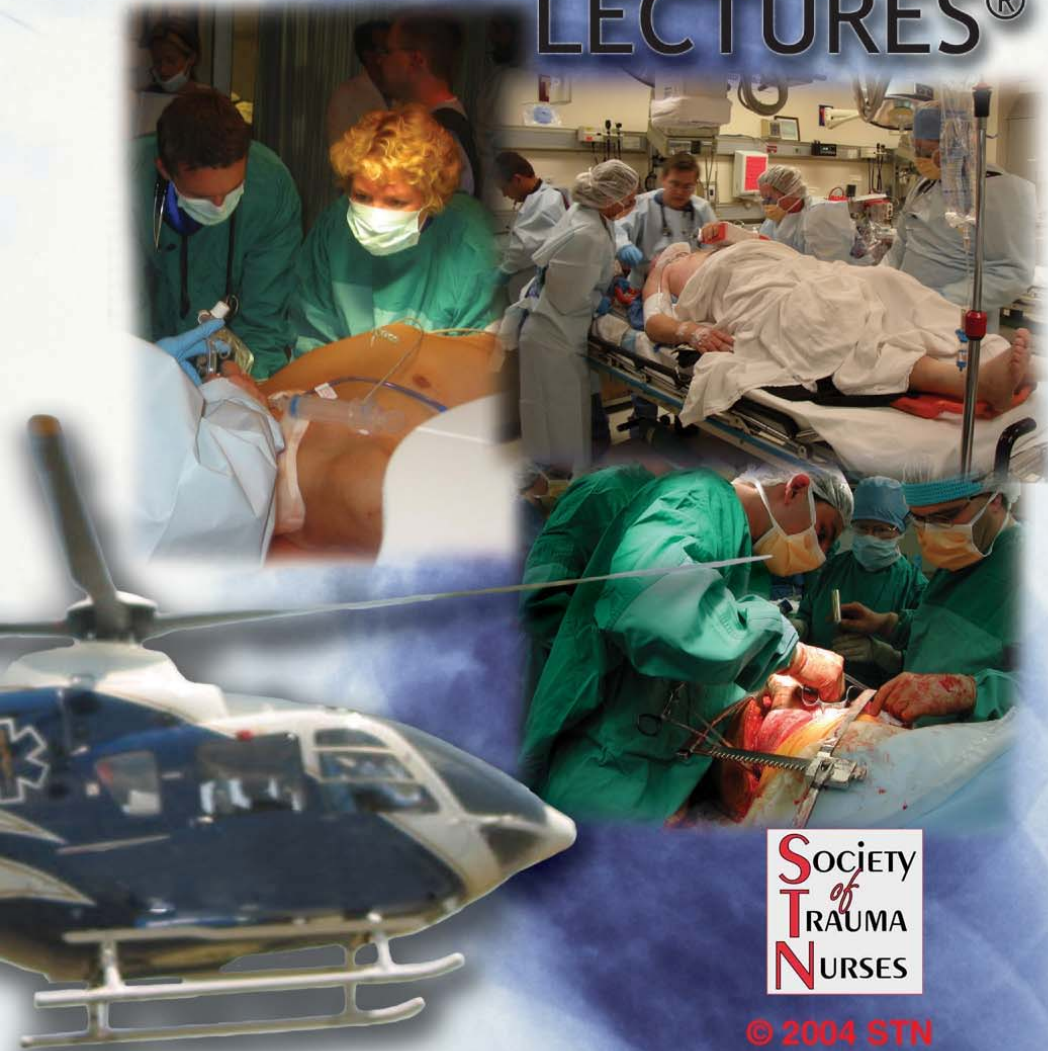


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Pediatric Trauma

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Objectives

At the end of this presentation the participant will be able to:

- Explain unique characteristics related to pediatric trauma care**
- Describe management considerations for the pediatric trauma patient**
- Describe assessment strategies in caring for critically injured child**

Pediatric Trauma

- Trauma is not an accident
- Trauma is a disease with predictable signs and symptoms
- Trauma is completely preventable
- Trauma is killing children in epidemic proportions

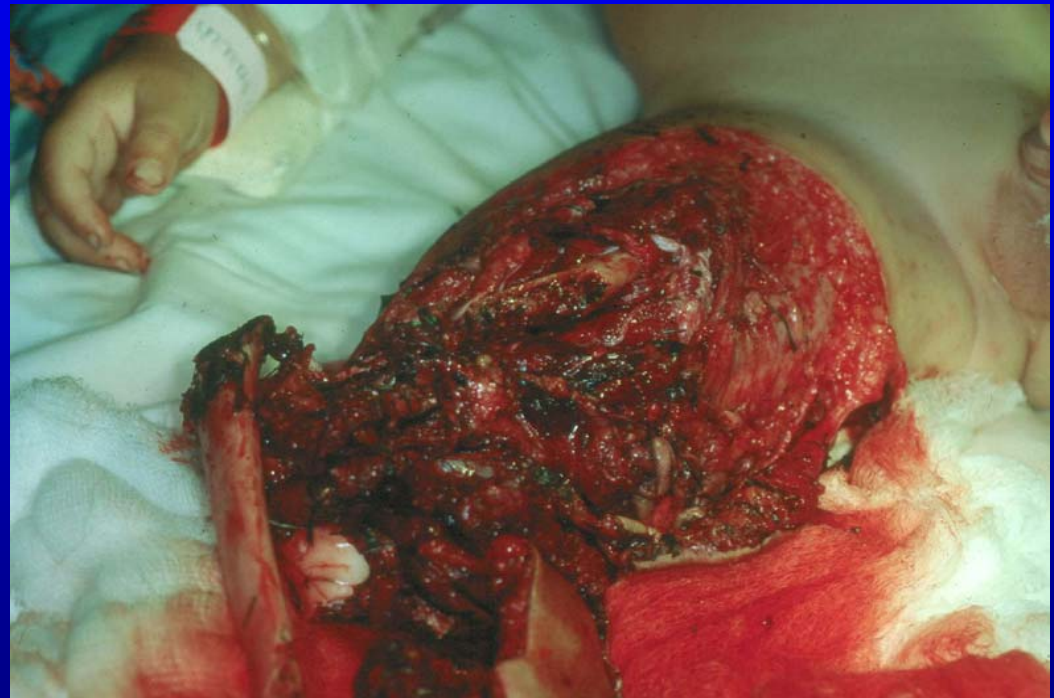


Epidemiology and Incidence

- **Trauma is leading cause of death and disability in children greater than 1 year old**
- **Motor vehicle crashes are the leading mechanism for fatal injuries**
- **Leading cause of non-fatal injury**
 - Falls
 - Burns
 - Drowning
 - Abuse
 - Firearm

Patterns of Injury

- **Injury Types**
 - **Blunt**
 - **Penetrating**



Anatomic Differences and Common Injuries

- **Anatomic factors that offer greater risk of injury**
 - Large head
 - Compliant chest wall
 - Less protected abdomen
 - More mobile kidneys
- **Common Injuries**
 - Head
 - Pulmonary contusions
 - Spleen
 - Liver



Injury Prevention Strategies

- **Restraints**
 - **Seatbelts, car seats, placement in the vehicle**
- **Bicycle, motorcycle, and ATV helmet use**
- **Smoke detectors, home drills**
- **Safety gates, fences, window locks**
- **Playground surface, height of equipment**
- **Education for parents**



Common Mechanisms and Injury Patterns

- Lap belt complex
- Pedestrian
- Child maltreatment



Child Maltreatment

Definition:

Child maltreatment, also known as abuse and neglect, is any act or failure to act on the part of a parent or caretaker that results in death, serious physical or emotional harm, sexual abuse or exploitation, or an act or failure to act that presents risk of serious harm.

Child Maltreatment

- **Common Physical Indicators**
 - Multiple injuries in various stages of healing
 - Injury type and location inconsistent with children's developmental level
 - Bruising, burns with characteristic pattern reflective of object used to cause injury
 - Signs of poor overall appearance and nutritional status

Airway Differences

- **Smaller upper and lower airways**
- **Tongue is larger relative to oropharynx**
- **Cartilage of the larynx is softer**
- **Larger head/body ratio**

Airway Differences

- **Infants obligate nose breathers**
- **Larynx is more anterior and cephalad**
- **Shorter trachea**
- **Cricoid cartilage is narrowest portion**

Respiratory Differences

- **Cartilaginous ribs are compliant**
- **Intercostal muscles are poorly developed**
- **Less compensatory reserve**
- **Less elastic and collagen tissue**
- **Have thin chest walls**



Circulatory Differences

- Myocardium is less compliant and has less contractile tissue
- Greater ability to compensate for decreasing cardiac output by increasing vascular resistance
- Smaller overall blood volume
- Bradycardia most common terminal cardiac rhythm

Metabolic and Thermoregulation

- **Children have less insulating subcutaneous tissue and fat stores**
- **Infants less than 3 months of age cannot produce heat by shivering**
- **Children have higher metabolic rates**

Developmental Approach

- Age
- Development issues
 - Magical thinking, minimal language
- Fears
 - Stranger and separation anxiety
- Appropriate interventions for age
 - Play, distraction



General Pediatric Principles

- **Include family**
- **Incorporate distraction measures**
- **Be truthful**
- **Provide age appropriate comfort measures**
- **Explain based on growth and development factors**
- **Respect modesty**

Approximate Weights



Approximate Weights

<u>Age</u>	<u>Weight (kg)</u>
6 months	6
1 year	10
3 years	15
5 years	20
8 years	25
10 years	30
16 years	50

Resuscitation Phase

- **Priorities of management**
 - Primary and secondary survey
 - Patient response to interventions
 - Evaluating severity of injury
 - Inclusion of family in care



Primary Assessment

- **Airway**
 - **Assessed for patency and adjuncts are initiated**
 - **Modified jaw-thrust (maintain C-spine control)**
 - **Suction**
 - **Oral airway**
 - **Endotracheal intubation (uncuffed in child less than 8 years)**
 - **Document ETT position (cm at lip or teeth)**
 - **Continually reassess tube position and breath sounds, especially after moving patient**

Primary Assessment

- **Maintain cervical and spinal alignment**
 - Use correct sized cervical collar
 - Generally children have short necks
 - Younger child may require padding under shoulders



Primary Assessment

- **Breathing**
 - **Observe for signs of respiratory distress**
 - **Grunting, nasal flaring, retractions**
 - **Inspect chest wall for deformity**
 - **Observe for respiratory effort**

Primary Assessment

- **Breathing**

- **Interventions may include**

- **Administration of 100% oxygen by non-rebreather mask**
 - **Assisted ventilation with bag valve mask**
 - **Intubation with positive pressure ventilation**

Primary Assessment

- **Circulation**
 - **Assess for signs of active bleeding**
 - **Small amounts of blood loss can quickly produce hypovolemic shock**
 - **A child's circulating blood volume is 80mL/kg**
 - **Monitor heart rate, systemic perfusion, and blood pressure**
 - **Warmed PRBCs after 2 fluid boluses**

Primary Assessment

- **Circulation**
 - **Interventions include**
 - **Direct pressure to active bleeding**
 - **Vascular access**
 - **Warmed fluid administration**
 - **Infuse 20 mL/kg warmed crystalloid solution quickly**
 - **Transfuse 10-15mL/kg warmed PRBCs after 2 fluid boluses**

Primary Assessment

- **Disability**
 - Use of a uniform system for level of consciousness
 - AVPU Scale
 - **A**lert, or only responds to **V**erbal or **P**ainful stimuli, or is **U**nresponsive
 - Glasgow Coma Score (GCS)
 - Pupil size, shape, symmetry and reaction to light

Primary Assessment

- **Exposure**
 - **Completely expose child to identify any life-threatening injuries**
 - **Provide warming measures**
 - **Monitor child's temperature regularly throughout resuscitation**

Secondary Survey

- **Head to toe assessment**
 - **Include pain assessment**
- **Continue to reassess**

Pediatric Trauma Resuscitation Pearls

Normal Heart/Respiratory Rates in Children

Age	Beats/Min	Resp/Min
Infants (0-1)	120-160	30-60
Toddlers (1-3)	90-140	24-40
Preschoolers (3-5)	80-110	22-34
School-aged(5-10)	75-100	18-30
Adolescents (10-19)	60-90	12-16

Pediatric Trauma Resuscitation Pearls

Normal Blood Pressure in Children

$$70 + 2x \text{ (age in years)} = \text{Systolic BP}$$

Endotracheal Tube Size Selection in Children

$$\frac{16 + \text{Age in years}}{4}$$

4

Hemorrhagic Shock

- **Generalized failure of adequate tissue perfusion resulting in impaired cellular and subcellular respiration**
- **Shock caused by blood loss and hypoxia**
- **Small margin of error in children**
- **Hemorrhage occurs more rapidly in the child (circulating blood volume is 80mL/kg)**

Hemorrhagic Shock

- **Compensatory mechanisms**
 - Children have the ability to vasoconstrict effectively and can compensate for up to a 25% blood loss
- **Hypotension is late sign**
 - Indicates a significant blood loss
- **Consider any child with significant trauma to be in shock until proven otherwise**
- **A child who is tachycardic, cold, mottled is in shock**

Hemorrhagic Shock

- **Signs and symptoms**
 - Tachycardia
 - Tachypnea
 - Capillary refill > 2 seconds
 - Narrowed pulse pressure
 - Weak or nonpalpable pulses
 - Diminished level of consciousness
 - Decreased urinary output
 - Decrease in systolic blood pressure
 - Late sign

Head Trauma

Pediatric Considerations

- **Brain tissues more pliable**
- **Head size greater in proportion to body surface area**
- **Larger proportion of total blood volume located in head**
- **Expandable fontanelles in younger children**
- **Secondary brain injury more common**
- **Most common cause of trauma death**

Pediatric Head Trauma

Neurologic Assessment

- **AVPU**
 - **A**lert, or only responds to **V**erbal or **P**ainful stimuli, or is **U**nresponsive
- **Glasgow Coma Score**
 - Use modified version for preverbal children
- **Reassessment**

Pediatric Head Trauma

Neurologic Assessment

- **Vital Signs**
- **Observe for signs of increased intracranial pressure**
 - **Cushing's phenomenon**
 - **Bradycardia**
 - **Hypertension, widening pulse pressure**
 - **Apnea, Cheyne-Stokes**
 - **Decreasing GCS**

Pediatric Head Trauma

Neurologic Assessment

- **Head and neck examination**
 - **Observe for obvious injury**
 - **Assess anterior fontanel in children < 18 months**
 - **Otorrhea**
 - **Battle's sign (ecchymosis in mastoid area)**
 - **Include face and oral cavity in assessment**

Pediatric Head Trauma Neurologic Assessment

- **Unique pediatric considerations**
 - **Suspected cervical spine injury**
 - **Spinal Cord Injury Without Radiographic Abnormality (SCIWORA)**

Pediatric Thoracic Trauma

Pediatric Considerations

- **Chest trauma not uncommon in children**
 - **Pulmonary contusions vs. fractures**
 - **Absent pre-existing disease**
 - **Compliant thorax**
 - **Mobile mediastinum**
 - **Aerophagia common**

Pediatric Thoracic Trauma

Cardiopulmonary Examination

- **Observe for abnormalities in breathing pattern**
 - **Nasal flaring, retractions, grunting, use of accessory muscles, rate, depth, symmetry of movement**
- **Cyanosis**

Pediatric Thoracic Trauma

Cardiopulmonary Examination

- **Distended neck veins and tracheal deviation**
 - **Difficult to see in the pediatric patient**
- **Observe for contusions, lacerations, deformities in the chest wall**

Pediatric Thoracic Trauma

Cardiopulmonary Examination

- **Palpate neck, clavicles, sternum, and thorax**
- **Auscultate**
 - **May have transmitted breath sounds because of thin walled and smaller sized chest**

Pediatric Abdominal Trauma

Pediatric Considerations

- **Peritoneal irritation may result in alteration of breathing pattern**
- **Auscultate although in the initial trauma resuscitation bowel sounds may be difficult to determine**
- **Palpate**
 - **Be gentle and creative in approach**
- **Rebound tenderness**

Pediatric Genitourinary Trauma

Pediatric Considerations

- **The perineal area is examined for lacerations, abrasions, contusions, swelling, and bleeding**
- **Palpate and apply gentle pressure over the iliac crests and symphysis pubis to assess the stability of the pelvis**
- **Check at the meatus for presence of blood**

Pediatric Extremity Trauma

Pediatric Considerations

- **Palpate all extremities to detect pain, swelling, bruising, lacerations, and deformities**
- **Observe for foreign bodies**
- **Temperature, movement, and pulses**
- **Eventual radiograph including the joint above and below**

The Family

- **Family presence**
- **Communication**
- **Death of a child**
- **Support services**

Critical Care Phase

- **Early recognition of subtle changes and rapid/efficient interventions**
- **Competency**

Critical Care Phase

- **Change of focus to total systems assessment**
- **Psychological status**
- **Response to resuscitation**
- **Operative interventions**

Critical Care Phase

- **Monitoring hemodynamic stability**
- **Respiratory support**
- **Extubation**
- **Monitoring neurologic status**
- **Complication prevention & treatment**
- **Nutritional support**
- **Pain management**

Critical Care Phase Pearls

Normal Pressure Values in Children

Central venous pressure	4-12mmHg
Systolic pulmonary artery pressure	20-30mmHg
Diastolic pulmonary artery pressure	<10mmHg
Mean pulmonary artery pressure	<20mmHg
Pulmonary artery wedge pressure	4-12mmHg

Critical Care Phase Pearls

Normal Urinary Output

Infant	2mL/kg per hour
Child	1-2mL/kg per hour
Adolescent	.5-1mL/kg per hour

Intermediate Care and Rehabilitation Phases

- **Clinical management**
- **Early involvement of rehabilitation**
- **Planning for discharge**
- **Community reintegration**



Summary

- **Prevention of injury is the best approach to pediatric trauma care**
- **Know pediatric norms in order to appreciate subtle changes**
- **Respect tachycardia as an early sign of shock**
- **Regard hypotension as a late and ominous sign in shock**
- **Assessment and re – assessment is key**
- **Integrate family into the child's care**
- **Early rehabilitation involvement**

Discussion/Questions?

- **Discuss the anatomical and physiological differences that the trauma nurse needs to be aware of when caring for pediatric trauma patients.**
- **Discuss strategies for fluid resuscitation in pediatric trauma patients.**