

Pediatric Trauma



Pediatric Trauma

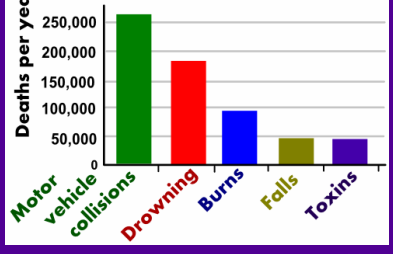
- ◆ Leading cause of death in children between the ages of 1 and 19 years
- ◆ For each death there are
 - ◆ 32 hospitalizations
 - ◆ 954 ED visits
 - ◆ 1866 visits to a doctor's office

CDC, 2000

Types of Injuries

- ◆ **1-5 years:** Child Abuse, Poisonings, Burns, Foreign body aspiration, and Falls
- ◆ **6-12 years:** Pedestrian accident injuries, and Non-vehicle bicycle accidents
- ◆ **13-19 years:** Motor vehicle accidents, Homicide, Suicide, Drowning and Motor vehicle vs. Bicycle accidents

Leading causes of death among children worldwide



June, 2009

Mechanism of Injury

- ◆ Blunt trauma
 - ◆ Falls
 - ◆ Physical Abuse
 - ◆ Motor Vehicle Accidents
- ◆ Penetrating trauma
- ◆ Other
 - ◆ Drownings





Physiological Differences

- ◆ Vital Signs
- ◆ Respiratory Reserve
- ◆ Blood Volume
- ◆ Higher Metabolic Rate
- ◆ Electrolyte imbalances



Anatomical Differences

- ◆ Head & Neck
- ◆ Airway
- ◆ Chest
- ◆ Abdomen
- ◆ Musculoskeletal System



Head & Neck

- ◆ Neck
- ◆ Occiput
- ◆ Head size
- ◆ Fontanels & Sutures
- ◆ Scalp



Airway

- ◆ Nasal passages
- ◆ Tongue, Tonsils, & Adenoids
- ◆ Larynx, Epiglottis, & Trachea



Chest

- ◆ Thorax
- ◆ Mediastinum
- ◆ Lungs



Abdomen

- ◆ Liver
- ◆ Spleen
- ◆ Duodenum
- ◆ Bladder
- ◆ Kidneys

Musculoskeletal System

- ◆ Bone properties
- ◆ Presence of growth plates
- ◆ Pseudosubluxation of C2 on C3

Weight

- ◆ Fluid resuscitation and medication administration in the pediatric population is based on the patient's body weight
- ◆ $2 \times \text{age (in years)} + 8$



Technical Interventions

- ◆ Interventions for infants and small children can be very time consuming, therefore, any intervention must be based on the patient's conditions, difficulty of the procedure, and the amount of time it will take to reach definitive care.

Specialized Equipment

- ◆ Size appropriate airway equipment
- ◆ Intravenous catheters
- ◆ Defibrillators
- ◆ Pulse oximetry

Trauma Scores

- ◆ Glasgow Coma Score
- ◆ Trauma Score
- ◆ Pediatric Trauma Score
- ◆ Injury Severity Scores

Developmental Issues



- ◆ Infants
 - ◆ Sucking is the major source of gratification and tension release
 - ◆ Separation anxiety begins at 5- 8 months
- ◆ Toddlers
 - ◆ Learn to say “no” to everything
 - ◆ Older toddlers often think that they have caused the illness or injury

Developmental Issues

- ◆ Preschoolers
 - ◆ May go willingly with a stranger
 - ◆ Very inquisitive - “why” or “what” questions
 - ◆ Children may feel guilty for being ill or injured
 - ◆ Regression may be seen
 - ◆ Magical thinking
 - ◆ Stalling techniques



Developmental Issues



- ◆ School-Age Children
 - ◆ Tolerate separation
 - ◆ Feelings of modesty
 - ◆ Comprehend simple explanations
- ◆ Adolescents
 - ◆ Want to be involved in decision-making
 - ◆ Very modest

Cognitive & Psychological Differences

- ◆ Encourage parents to remain with their children
- ◆ Explain what you are going to the child in language appropriate to their development
- ◆ Be gentle and minimize painful procedures
- ◆ Be mindful of embarrassing adolescents and listen to them

Head Trauma

Chest Trauma

Abdominal Injury

Musculoskeletal Injury

Spinal Cord Injury

Head Trauma

- ◆ Mild head injury is a common cause for Emergency Department visits
- ◆ 43% of all head injuries in children are related to sports and recreational activities
- ◆ 93% of all head-injured children are admitted to the hospital



Head Injury

- ◆ Scalp lacerations
- ◆ Skull fractures
- ◆ Concussion
- ◆ Contusion
- ◆ Hematomas



Scalp Lacerations

- ◆ The scalp is highly vascular and may result in profuse bleeding when injured
- ◆ A subgaleal hematoma may be the only sign of intracranial injury in an infant. 73% of infants with an Epidural Hematoma also had a significant subgaleal hematoma



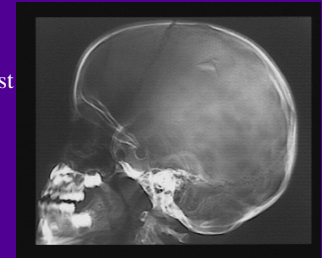
Skull Fractures

- ◆ Linear
- ◆ Depressed
- ◆ Compound
- ◆ Basilar



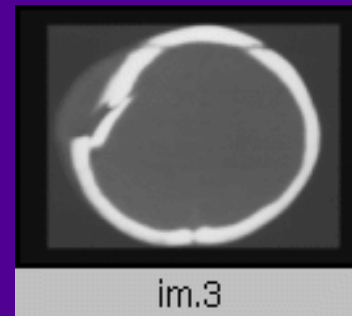
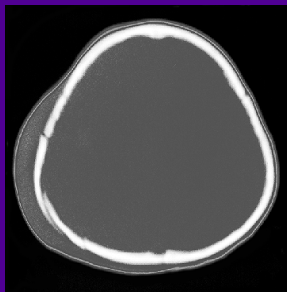
Linear Skull Fractures

- ◆ 75 - 90% of skull fractures in children
- ◆ Parietal bone is the most common site of skull fractures



Depressed Skull Fracture

- ◆ Disruption of the integrity of the skull
- ◆ Considered clinically significant if the bone fragment is depressed below the inner table of the skull to a depth greater than the full thickness of the skull



Basilar Skull Fracture

- ◆ Frequent site of fracture
- ◆ Signs & Symptoms
 - ◆ CSF Rhinorrhea
 - ◆ Hemotympanum
 - ◆ Ecchymosis behind the ear over the mastoid
 - ◆ Raccoon eyes



Concussion

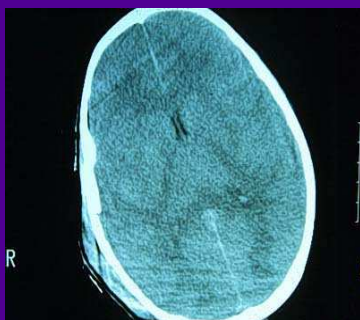
- ◆ Brief alteration in consciousness (with or without Loss of Consciousness) after sustaining a closed head injury
- ◆ This alteration in consciousness is accompanied by a flaccid motor state, followed by complete recovery
- ◆ May also be associated with a period of vomiting, pallor, confusion, or amnesia

Contusion

- ◆ Result of the brain parenchyma becoming bruised or crushed, resulting in hemorrhage and edema
- ◆ When brain injury occurs on the side of impact a coup lesion develops
- ◆ Damage to the opposite side of the brain from the site of impact is a contrecoup lesion

Diffuse Axonal Injury

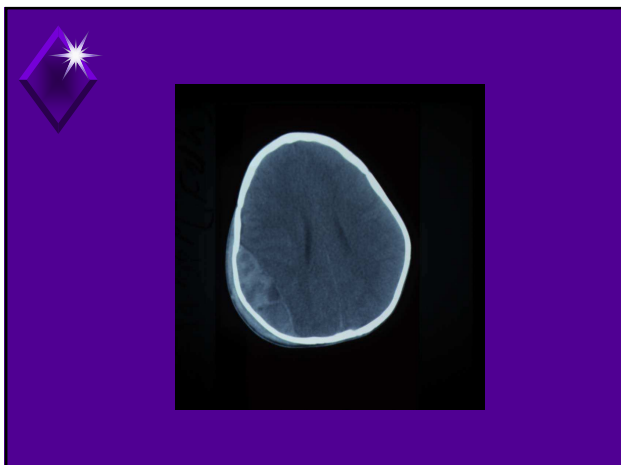
- ◆ Damage to the axons of the Central Nervous System can be caused by the shearing forces associated with Closed Head Injuries
- ◆ DAI may accompany concussion, contusion & subdural hematomas
- ◆ May lead to temporary alterations in consciousness, neurological deficits and in the most severe cases; coma




Hematomas

- ◆ Epidural
 - ◆ 2% of all serious head injuries
 - ◆ Arterial in nature, middle meningeal artery tear
 - ◆ Associated with Skull Fractures in 40-85% of cases
 - ◆ Transient loss of consciousness followed by a lucid interval

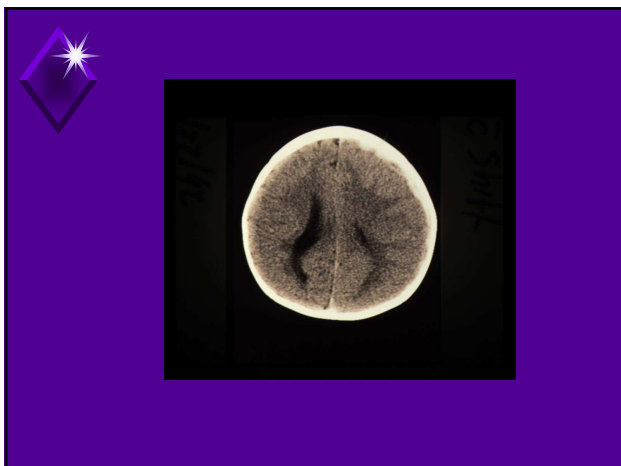




Hematomas



- ◆ Subdural
 - ◆ 5% of all head trauma patients
 - ◆ Damage to the subdural veins “bridging veins”
 - ◆ Manifest hours after injury
 - ◆ Underlying brain injury occurs in 50% of cases



Chest Trauma

- ◆ Responsible for 10 - 25% of acute deaths
- ◆ Contributes to up to 50% of other deaths
- ◆ May have associated abdominal trauma
- ◆ Blunt injury is the most common cause

Chest Trauma

- ◆ Pneumothorax
- ◆ Hemothorax
- ◆ Flail Chest
- ◆ Traumatic asphyxia
- ◆ Cardiac tamponade
- ◆ Myocardial contusion
- ◆ Aortic rupture

Pneumothorax

- ◆ Open
- ◆ Closed
- ◆ Tension

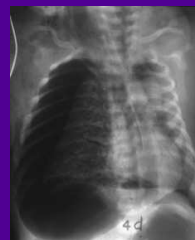
Open Pneumothorax

- ◆ Etiology: Penetrating trauma
- ◆ Pathophysiology
 - ◆ Loss of chest wall integrity
 - ◆ Involved lung collapses on inspiration and expands slightly on expiration
 - ◆ Inability to generate negative pressure
- ◆ Treatment: Dressing secured on three sides only



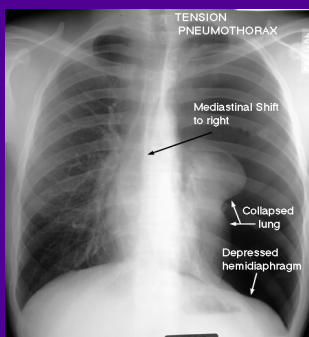
Tension Pneumothorax

- ◆ Etiology
 - ◆ Blunt Trauma
 - ◆ Penetrating Trauma
 - ◆ Mechanical ventilation
- ◆ Diagnosis
 - ◆ Neck veins distended
 - ◆ Trachea deviated
 - ◆ Shock



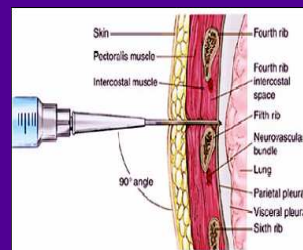
Tension Pneumothorax

- ◆ Pathophysiology
 - ◆ Pleural pressure rises
 - ◆ Lung collapses
 - ◆ Mediastinum shifts
 - ◆ Opposite lung compressed
 - ◆ Vena Cava kinks
 - ◆ Decreased venous return
 - ◆ Decreased cardiac output



Needle Decompression

- ◆ Equipment: 14 or 16G over the needle catheter
- ◆ Procedure: Patient in the supine position, place the needle in the second intercostal space, midclavicular line



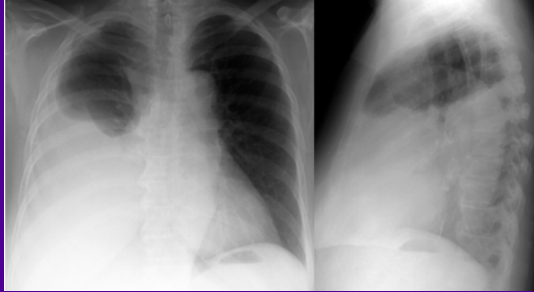
Hemothorax

- ◆ Etiology
 - ◆ Blunt trauma
 - ◆ Moderate blood loss
 - ◆ Bleeding sites usually located on the chest wall or lung parenchyma
 - ◆ Penetrating trauma
 - ◆ Risk of massive blood loss
 - ◆ Bleeding: aorta, systemic, or pulmonic vessels, heart

Hemothorax

- ◆ Pathophysiology
 - ◆ Laceration to a vessel, bleeding from the lung
 - ◆ Accumulation of blood in the pleural space leads to hypoxia resulting from ventilatory compromise
- ◆ Radiograph
 - ◆ Supine film may miss blood loss approaching 30% estimated blood loss

Hemothorax



Tube Thoracostomy

- ◆ Procedure: Placement at the 4th or 5th intercostal space, mid-axially line
- ◆ Equipment: Chest Tube
 - ◆ Newborn 12fr
 - ◆ 1 - 2 years 16fr
 - ◆ 5 years 24fr
 - ◆ 10 years 32fr
 - ◆ Adult 36fr

Rib Fractures

- ◆ Rare in healthy infants and children
- ◆ Etiology
 - ◆ 82% caused by abuse in infants
 - ◆ 8% accidental (major trauma)
 - ◆ 7% fragile bones
 - ◆ 3% birth trauma

Rib Fractures

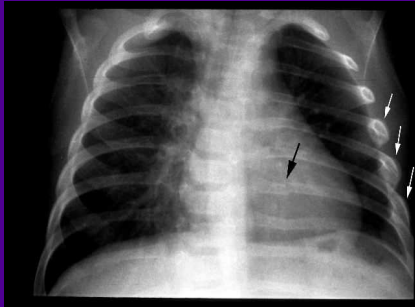
- ◆ Signs & Symptoms
 - ◆ Tachypnea with shallow breathing
 - ◆ Pain on inspiration
 - ◆ Tenderness
 - ◆ Crepitus
 - ◆ Swelling over fracture site

Rib Fractures

- ◆ Rare due to resilient rib cage
- ◆ Presence suggests massive force
- ◆ Predictive of severe organ injury
- ◆ May be complicated by flail chest, pneumothorax, hemothorax, pulmonary contusion
- ◆ May cause liver and spleen injury

Rib Fractures

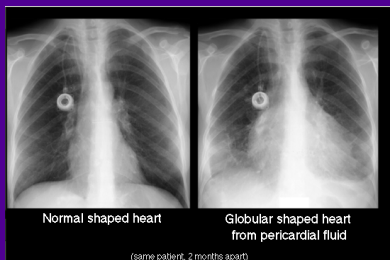
- ◆ Treatment
 - ◆ Pain relief
 - ◆ Bed-rest
 - ◆ Restrictive bandaging is not useful
 - ◆ Cough and deep breathing with splint pillow



Cardiac Tamponade

- ◆ Pathophysiology
 - ◆ Accumulation of blood in the pericardial sac
 - ◆ Heart cannot fill during diastole
 - ◆ Low cardiac output
- ◆ Diagnostic Triad
 - ◆ Shock
 - ◆ Distended neck veins
 - ◆ Muffled heart sounds

Cardiac Tamponade



Pericardiocentesis

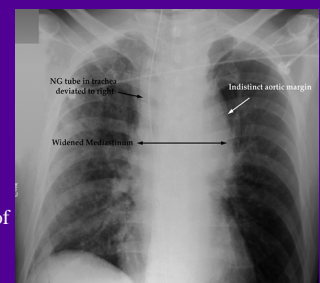
- ◆ Procedure: Position the patient in reverse trendelenberg. Attach a needle to ECG lead and insert needle at a 45 degree angle one centimeter to the left of the xiphoid process.

Myocardial Contusion

- ◆ Etiology
 - ◆ Blunt trauma - sharp direct blow to the sternum
- ◆ Presentation
 - ◆ Chest pain, Sinus tachycardia, ST -wave changes
- ◆ Treatment
 - ◆ Oxygen, analgesics, cardiac monitoring

Aortic Rupture

- ◆ Pathophysiology
 - ◆ Descending aorta is relatively fixed
 - ◆ Sudden deceleration
 - ◆ Shearing forces on the aorta at the isthmus
- ◆ Radiographic signs
 - ◆ Increase in the width of the superior Mediastinum



Abdominal Injury

- ◆ Splenic Injury
- ◆ Liver Injury
- ◆ Lap belt complex

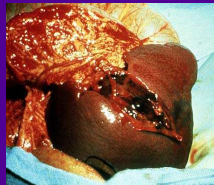
Splenic Injury



- ◆ Etiology
 - ◆ Blunt trauma to the upper abdomen or lower thorax.
 - ◆ 50 % related to recreational activities
- ◆ Treatment
 - ◆ Aimed toward splenic preservation
 - ◆ ICU monitoring for 48hours
 - ◆ Blood transfusions
 - ◆ Splenectomy

Liver Injury

- ◆ Etiology: Blunt trauma
- ◆ Classifications
 - ◆ Contusions
 - ◆ Parenchymal lacerations
 - ◆ Injuries to the hepatic vein or vena cava
- ◆ Treatment
 - ◆ Non-operative management
 - ◆ Liver resection



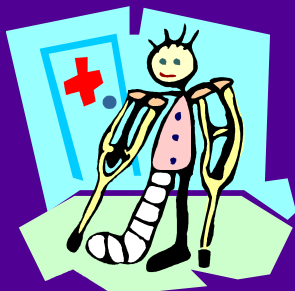
Lap belt Complex

- ◆ Anatomical differences
- ◆ Mechanism of injury
 - ◆ Deceleration
 - ◆ Compression
- ◆ Injury pattern
 - ◆ Hip & Abdominal Contusions
 - ◆ Lumbar spine injuries
 - ◆ Intrabdominal injuries



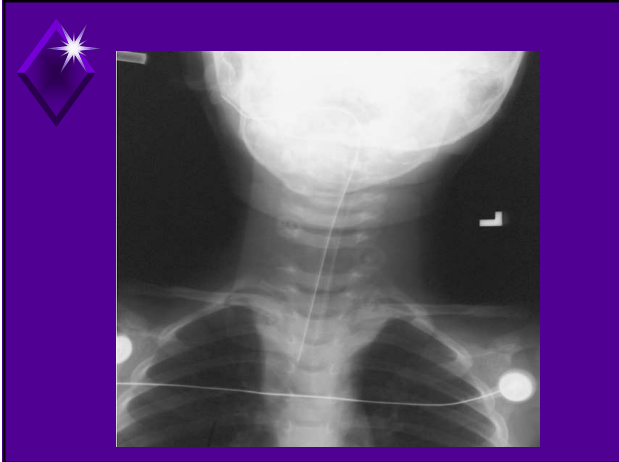
Musculoskeletal Injury

- ◆ Extremity trauma
 - ◆ Fractures
 - ◆ Subluxations & Dislocations
 - ◆ Amputations



Spinal Cord Injuries

- ◆ SCIWORA
 - ◆ Spinal
 - ◆ Cord
 - ◆ Injury
 - ◆ Without
 - ◆ Radiographic
 - ◆ Abnormalities



Spinal Cord Injury

- ◆ High dose Methylprednisolone
 - ◆ Indications
 - ◆ Complete & incomplete spinal cord injury less than 8 hours old
 - ◆ Dosage
 - ◆ 30 mg/kg bolus with 4 hours of injury over 15 mins
 - ◆ 45 minute pause
 - ◆ 23 maintenance infusion = 5.4 mg/kg/hr



The Injured Family

- ◆ The Calgary Family Assessment Model
 - ◆ Structural Assessment
 - ◆ Developmental Assessment
 - ◆ Functional Assessment



Structural Assessment

- ◆ Internal Structure
 - ◆ Who are the members of the family
- ◆ External Structure
 - ◆ How the family is related to an extended family and their social system
- ◆ Context
 - ◆ Sociocultural background of the family



Developmental Assessment

- ◆ Life Cycle
- ◆ Family Tasks
- ◆ Relational Attachments



Functional Assessment

- ◆ Instrumental functioning
- ◆ Expressive functioning



Primary Survey

- ◆ Airway
- ◆ Breathing
- ◆ Circulation



Airway Management

- ◆ 100% oxygen
- ◆ Suctioning
- ◆ Jaw thrust or chin lift
- ◆ Oral airway
- ◆ Oro-tracheal intubation
- ◆ Cricothyroidotomy vs. Tracheostomy



Circulation

- ◆ Hypovolemic clues
 - ◆ Vital signs & blood pressure guidelines vary with age
 - ◆ Tachycardia can be caused by multiple factors
 - ◆ Fixed stroke volume so compensate for hypovolemia by increasing heart rate
 - ◆ Efficient compensation makes recognition of shock difficult – assess perfusion
- ◆ Hemorrhage control
- ◆ Intravenous access
- ◆ Fluid resuscitation
- ◆ Maintain CPP > 40 mm Hg

Circulation

- ◆ Hemorrhage control
- ◆ Intravenous access
- ◆ Fluid resuscitation
- ◆ Maintain CPP > 40 mm Hg

Etiologies of Shock

- ◆ Hypovolemic Fluid Loss
- ◆ Distributive Neurogenic
- ◆ Cardiogenic Pump Failure
- ◆ Obstructive Tamponade

Disability

- ◆ AVPU evaluation system
 - ◆ Alert
 - ◆ Responds to verbal commands
 - ◆ Responds to pain
 - ◆ Unresponsive
- ◆ Control of Intracranial Pressure
 - ◆ 3 % Normal Saline

Expose, Examine, Emotional Support

- ◆ Undress
- ◆ Avoid Hypothermia

Secondary Survey

- ◆ Head to toe evaluation
- ◆ Fingers and tubes in every orifice
- ◆ Review history
- ◆ Assess and assign trauma scores
- ◆ Laboratory analysis
- ◆ Radiographic studies



Monitoring

- ◆ Vital signs, CPP > 40 mmHg
- ◆ ECG
- ◆ Pulse oximeter
- ◆ End Tidal CO2 monitor
- ◆ Urine Output
- ◆ Arterial blood gas
- ◆ Frequent reexamination

Transfer

- ◆ Indications
- ◆ Team composition
- ◆ Vehicle
 - ◆ Ground ambulance
 - ◆ Fixed wing
 - ◆ Helicopter
- ◆ Equipment



Ethical Principles in Pediatric Trauma Nursing

- ◆ Autonomy
- ◆ Nonmaleficence
- ◆ Beneficence
- ◆ Justice

Ethical Principles

- ◆ Autonomy
 - ◆ A person's individual freedom to choose his or her own course and make personal decisions
 - ◆ Issues to consider
 - ◆ Age, cognition, developmental level
 - ◆ Family Presence during resuscitation

Ethical Principles

- ◆ Nonmaleficence
 - ◆ The obligation not to inflict intentional harm
 - ◆ Withholding care
 - ◆ Withdrawing treatment
- ◆ Beneficence
 - ◆ Do Good
 - ◆ Protecting the rights of others, preventing harm, helping persons with disabilities
 - ◆ Child Abuse

Ethical Principles

- ◆ Justice
 - ◆ Distributive justice
 - ◆ Fair, equitable, and appropriate distribution of resources, privileges, and opportunities
 - ◆ Expensive, Highly technical interventions
 - ◆ ICU Beds

Questions?????

- ◆ Thank you for your attention
- ◆ Kirsten.Johnson-Moore@tenethealth.com