Trauma Care

• Includes:
  – Rapidly identifying injuries
  – Transporting patients to appropriate trauma center for definitive care
  – Providing scene safety
  – Performing trauma assessment in all cases
Newton’s Laws of Motion

• Newton’s First Law
  – “A body in motion remains in motion in a straight line unless acted upon by an outside force.”

• Newton’s Second Law
  – “Acceleration depends on the mass of the object and the force upon it.”

• Newton’s Third Law
  – “To every action, there is an equal and opposite reaction.”
Types of Trauma (1 of 2)

• Blunt injuries
  – Energy exchange between an object and body without breaking skin

• Penetrating injuries
  – External force in which tissue is penetrated by an object
Types of Trauma (2 of 2)

• Deceleration injuries
  – Caused by a sudden stop of body’s forward motion

• External force injuries
  – Caused by forces that violate body tissues
  – Injury depends on anatomic area, mass, and velocity of foreign object.
Factors That Might Require Trauma Center (1 of 2)

- Ejection from automobile
- Death in same passenger compartment
- Pedestrian thrown or run over, auto–pedestrian injury greater than 5 mph
- High-speed automobile crash
- Intrusion into passenger compartment of greater than 12”
- Major vehicle deformity greater than 20”
Factors That Might Require Trauma Center (2 of 2)

- Vehicle rollover with unrestrained passenger
- Extrication time greater than 20 minutes
- Falls of greater than 20’
- Motorcycle crash at greater than 20 mph or with separation of rider and bike
Triage

• Doing the greatest good for the greatest number

• Four common triage categories
  – Immediate (red)
  – Delayed (yellow)
  – Minimal (green)
  – Expectant (black)
Types of Triage

• START triage
  – Step 1: Identifies walking wounded
  – Step 2: Assesses nonwalking patients
  – Step 3: Assesses hemodynamic status by checking radial pulse
  – Step 4: Assesses neurologic status

• JumpSTART triage
  – Modifies process for pediatric patients under 8 years or weighing less than 100 lb
Trauma Scoring Systems (1 of 6)

- **Glasgow Coma Scale (GCS)**
  - Assesses level of consciousness: eye opening, verbal response, motor response

- **Trauma score**
  - Predicts likelihood of patient survival
  - Score ranges 1–16
  - Includes GCS
  - Not useful with severe head injuries
## Trauma Scoring Systems (2 of 6)

### GLASGOW COMA SCALE

<table>
<thead>
<tr>
<th>Eye Opening</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td>To voice</td>
<td>3</td>
</tr>
<tr>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Verbal Response</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oriented</td>
<td>5</td>
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<tr>
<td>Confused</td>
<td>4</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor Response</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Obeys command</td>
<td>6</td>
</tr>
<tr>
<td>Localizes pain</td>
<td>5</td>
</tr>
<tr>
<td>Withdraws (pain)</td>
<td>4</td>
</tr>
<tr>
<td>Flexion (pain)</td>
<td>3</td>
</tr>
<tr>
<td>Extension (pain)</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

**Glasgow Coma Scale Maximum Score** | **Total** | **15**

**Glasgow Coma Scale Minimum Score** | **Total** | **3**
Trauma Scoring Systems (3 of 6)

• Revised trauma score
  – Most commonly used scoring system to determine severity of injury
  – Measures respiratory rate, systolic blood pressure, GCS score

• Abbreviated Injury Scale (AIS)
  – Ranks severity of injury by reviewing six body regions
# Trauma Scoring Systems (4 of 6)

<table>
<thead>
<tr>
<th>Revised Trauma Score</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>GCS: 13-15&lt;br&gt;Systolic blood pressure: &gt; 89 mm Hg&lt;br&gt;Respiratory rate: 10-29 breaths/min</td>
</tr>
<tr>
<td>3</td>
<td>GCS: 9-12&lt;br&gt;Systolic blood pressure: 76-89 mm Hg&lt;br&gt;Respiratory rate: &gt; 29 breaths/min</td>
</tr>
<tr>
<td>2</td>
<td>GCS: 6-8&lt;br&gt;Systolic blood pressure: 50-75 mm Hg&lt;br&gt;Respiratory rate: 6-9 breaths/min</td>
</tr>
<tr>
<td>1</td>
<td>GCS: 4-5&lt;br&gt;Systolic blood pressure: 1-49 mm Hg&lt;br&gt;Respiratory rate: 1-5 breaths/min</td>
</tr>
<tr>
<td>0</td>
<td>GCS: 3&lt;br&gt;Systolic blood pressure: 0 mm Hg&lt;br&gt;Respiratory rate: 0 breaths/min</td>
</tr>
</tbody>
</table>

Abbreviation: GCS, Glasgow Coma Scale.
Reproduced from Revised Trauma Score. © Trauma.org
Trauma Scoring Systems (5 of 6)

- Injury Severity Score (ISS)
  - Provides overall score for patients with multiple injuries
  - Incorporates AIS score
- Trauma injury severity score
  - Calculates survival probability of critically ill or injured patient
  - Not commonly used in transport setting
Levels of Trauma Care (1 of 2)

- Level I: Provides every aspect of trauma care from prevention through rehabilitation
- Level II: Provides initial definitive care
- Level III: Provides assessment, resuscitation, emergency care, stabilization
- Level IV: Provides advanced trauma life support prior to transfer
# Levels of Trauma Care (2 of 2)

**TABLE 10-3 American College of Surgeons Recommendations for a Level II Patient**

| Patient characteristic/condition indicators | 1. Glasgow Coma Scale score of < 14 when associated with trauma  
|                                           | 2. Respiratory rate of < 10 or > 29 breaths/min (< 20 breaths/min in an infant younger than 1 year) when associated with trauma  
|                                           | 3. Penetrating wounds (other than gunshot wounds) to the head, neck, torso, and extremities proximal to the elbow and knee  
|                                           | 4. Flail chest  
|                                           | 5. Combination of trauma with burns  
|                                           | 6. Two or more proximal long bone fractures  
|                                           | 7. Pelvic fractures  
|                                           | 8. Limb paralysis and/or spinal cord injury  
|                                           | 9. Amputation proximal to the wrist and/or ankle  
| Mechanism of injury indicators            | 1. High-speed automobile crash  
|                                           |   • Initial speed > 40 mph  
|                                           |   • Major automobile deformity  
|                                           |   • Intrusion into the passenger compartment  
|                                           | 2. Ejection from the automobile  
|                                           | 3. Death in same passenger compartment  
|                                           | 4. Extrication time > 20 minutes  
|                                           | 5. Falls > 20' or significant falls in children or elderly  
|                                           | 6. Automobile rollover  
|                                           | 7. Automobile vs pedestrian or automobile vs bicycle impact > 5 mph  
|                                           | 8. All-terrain vehicle or motorcycle crash > 20 mph or separation of rider from vehicle  
| Consider Level II classification with these preexisting conditions | 1. Age younger than 5 years or older than 55 years  
|                                           | 2. Cardiac or respiratory disease  
|                                           | 3. Insulin-dependent diabetes mellitus, cirrhosis of the liver, or morbid obesity  
|                                           | 4. Pregnancy  
|                                           | 5. Immunosuppressed patients  
|                                           | 6. Patients with a bleeding disorder or receiving anticoagulants  

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General Trauma Management

• Involves patients who are very ill and in need of close assessment

• Immediate attention directed at the ABCs
  – Assess placement of the endotracheal tube, presence of breath sounds, capnography waveform
  – Assess cardiovascular status
Effects of Hypothermia on Trauma Patients

<table>
<thead>
<tr>
<th>TABLE 10-4</th>
<th>Effects of Hypothermia on Trauma Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impaired cardiorespiratory function</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiac depression</td>
<td></td>
</tr>
<tr>
<td>Myocardial ischemia</td>
<td></td>
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<tr>
<td>Arrhythmias</td>
<td></td>
</tr>
<tr>
<td>Peripheral vasoconstriction</td>
<td></td>
</tr>
<tr>
<td>Impaired tissue oxygen delivery</td>
<td></td>
</tr>
<tr>
<td>Elevated oxygen consumption during rewarming</td>
<td></td>
</tr>
<tr>
<td>Blunted response to catecholamines</td>
<td></td>
</tr>
<tr>
<td>Increased blood viscosity</td>
<td></td>
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<tr>
<td>Metabolic acidosis</td>
<td></td>
</tr>
<tr>
<td><strong>Bleeding diathesis</strong></td>
<td></td>
</tr>
<tr>
<td>Decreased kinetics of coagulation factors</td>
<td></td>
</tr>
<tr>
<td>Reduced platelet function</td>
<td></td>
</tr>
<tr>
<td><strong>Reduced clearance of drugs</strong></td>
<td></td>
</tr>
<tr>
<td>Decreased hepatic blood flow</td>
<td></td>
</tr>
<tr>
<td>Decreased hepatic metabolism</td>
<td></td>
</tr>
<tr>
<td>Decreased renal blood flow</td>
<td></td>
</tr>
<tr>
<td><strong>Increased risk of infection</strong></td>
<td></td>
</tr>
<tr>
<td>Decreased white blood cell number and function</td>
<td></td>
</tr>
<tr>
<td>Impaired cellular immune response</td>
<td></td>
</tr>
<tr>
<td>Wound infection</td>
<td></td>
</tr>
<tr>
<td>• Thermoregulatory vasoconstriction</td>
<td></td>
</tr>
<tr>
<td>• Decreased subcutaneous oxygen tension</td>
<td></td>
</tr>
<tr>
<td>• Impaired oxidative killing by neutrophils</td>
<td></td>
</tr>
<tr>
<td>• Decreased collagen deposition</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td></td>
</tr>
<tr>
<td><strong>Insulin resistance with hyperglycemia</strong></td>
<td></td>
</tr>
</tbody>
</table>

Anatomy of Thorax

Anterior:
- Clavicle
- Pericardium
- Heart
- Lung
- Pleura
- Diaphragm

Suprasternal notch
- Manubrium
- Angle of Louis
- Xyphoid process

Posterior:
- Scapula
- Ribs
- Intercostal space

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Types of Pneumothorax

- **Open pneumothorax**
  - Signs: “sucking chest wound,” dyspnea, tachypnea

- **Simple pneumothorax**
  - Often associated with closed chest injury

- **Tension pneumothorax**
  - Life-threatening, results from continual influx of air into pleural space
Open Pneumothorax
Skill Drill 10-1: Managing an Open Pneumothorax (1 of 2)

Maintain an open airway and administer high-flow oxygen.

Immediately close the chest wound, initially with a gloved hand.

Apply an occlusive dressing, taped down on three sides.
Hemothorax (1 of 2)

• Blood in pleural space
• Causes
  – Hypovolemic shock
  – Harms lung function
• Caused by:
  – Penetrating and blunt trauma
  – Tumor
Hemothorax (2 of 2)

- Blood-filled pleural space
- Wound site
- Parietal pleura
- Collapsed lung
- Visceral pleura

Lung
Heart
Chest Tube Insertion (1 of 2)

• Used to remove air, fluid, pus from pleural cavity

• Indicated for treatment of:
  – Pneumothorax, hemopneumothorax, empyema
Other Forms of Thoracic Trauma (1 of 5)

- Flail chest
  - Fracture in two or more places to two or more adjacent ribs; may initially go undetected

- Pericardial tamponade
  - Abundance of blood, fluid in pericardium; life-threatening; Beck’s triad indicator; requires emergency pericardiocentesis
Other Forms of Thoracic Trauma (2 of 5)

Pericardiocentesis
Other Forms of Thoracic Trauma (3 of 5)

• Aortic dissection/transaction
  – Aortic rupture; most common cause of immediate death in MVCs

• Myocardial contusion
  – Caused by blunt chest trauma; signs similar to acute MI

• Diaphragmatic rupture
  – Caused by both blunt and penetrating trauma
Other Forms of Thoracic Trauma (4 of 5)

- Tracheobronchial disruption
  - Rare, life-threatening; can occur anywhere along tracheobronchial tree
- Pulmonary contusion
  - Tearing, lacerations to lungs can cause bleeding, plasma leakage into alveoli and interstitial spaces
Other Forms of Thoracic Trauma (5 of 5)

- Esophageal perforation
  - Usually caused by penetrating injuries like projectiles
- Traumatic asphyxia
  - Severe, sudden crushing injury to chest and abdomen
  - Not a form of asphyxia, but patient’s head and neck turn cyanotic
Ear Injuries

- External ear injury
  - Local injury, no acute systemic implications
  - Perform halo test if fluid, blood leaking from auditory canal

- Ruptured tympanic membrane
  - Overpressure injury or failure to equalize middle ear pressure
  - Most heal spontaneously
Eye Injuries (1 of 2)

- Eyelid lacerations
  - Apply direct pressure; do not push on globe; consider concomitant eye injuries

- Conjunctival and corneal injuries
  - Prevent eye and implanted object from moving during transport; patch unaffected eye

- Hyphema
  - Requires full ophthalmologic examination
Eye Injuries (2 of 2)

• Ocular globe rupture
  – Protect affected eye with rigid eye shield or cup

• Ocular avulsion
  – Protect affected eye with rigid eye shield or cup

• Traumatic retinal detachment
  – Avoid pressure to globe; protect eye with shield
Other Forms of Facial Trauma

• Mandibular fracture and dislocation
  – Provide for emergency airway during transfers when patient’s jaw is wired shut

• Dental avulsion
  – Reimplantation possible if done within an hour
  – Follow ADA guidelines for transporting tooth
Neck Injuries

- Laryngotracheal injuries
  - Uncommon; provide airway management with careful endotracheal intubation
- Thyroid injuries
  - Consider thyrotoxicosis, prepare to manage
- Vascular neck injuries
  - Exsanguination, hematoma, air embolization
Abdominal Trauma (1 of 2)

- Difficult to recognize
- May cause life-threatening hemorrhage, serious organ damage
  - Grey-Turner’s sign, Cullen’s sign
- Requires assessment pretransport to determine blood loss
  - Inspect, auscultate, palpate
Abdominal Trauma (2 of 2)

• Signs and symptoms
  – Altered mental status
  – Tachycardia
  – Absence of palpable pulses
  – Pale, moist, and mottled skin
  – Poor peripheral perfusion
  – Hypotension
Hollow vs Solid Organs

• Hollow organs
  – Leak contents when injured (peritonitis)
  – Include stomach, intestines, gallbladder, urinary bladder, ureters, uterus, great vessels

• Solid organs
  – Bleed when injured
  – Include liver, spleen, pancreas, kidneys
Hollow vs Solid Organ Injury (1 of 3)

• Spleen
  – Most commonly injured abdominal organ; highly vascular; Kehr’s sign

• Liver
  – Largest, most vascular organ; Kehr’s sign

• Large and small intestines
  – Penetrating trauma most common; seatbelt injury from blunt trauma
Hollow vs Solid Organ Injury (2 of 3)

• Stomach
  – Damage from trauma rare

• Duodenum
  – Well-protected; may not produce symptoms of injury

• Jejunum and ileum
  – Frequently injured by gunshot and stab wounds
Hollow vs Solid Organ Injury (3 of 3)

- Vascular injuries
  - Usually life-threatening when a major vessel is injured
  - Vessels include: aorta, inferior vena cava, renal artery, mesenteric artery, iliac artery
  - Transfer immediately to trauma center for surgery
Pelvic Trauma

• Results from significant force
  – May involve additional injuries
• Can lead to catastrophic hemorrhage
• Includes open-book fracture
  – Pelvis separated at symphysis pubis
Extremity Trauma

- Rarely life threatening
- Include fractures, sprains, strains, dislocations, muscular contusions, compartment and crush syndromes
- Possible indicator of amount of energy transferred to body
- Assess for six Ps:
  - Pain, pallor, pulselessness, paresthesia, paralysis, pressure
Fractures

- Closed: Skin remains intact, less chance of infection
- Open: Skin over bone broken; infection possible
- Signs and symptoms: pain, swelling, deformity, rigidity, shortening, ecchymosis
- Management: Maintain airway, assess and reassess pulses, splint in anatomic position
Femur Fracture

- Largest bone in the body
- The slack muscle can provide a large space for the collection of blood.
- Contraindications
  - Hip and pelvic fractures
  - Knee injury
  - Ankle damage
Vertebral Fracture

- Trauma is the leading cause of injury.
- Can result in permanent devastating neurologic deficits
- Mechanism of injury includes:
  - Flexion
  - Flexion with rotation
  - Extension
  - Compression
Cervical Fracture

• Most devastating vertebral fractures occur in the seven cervical vertebrae
  – Control of the entire body descends here.
• May compromise respiratory effort
Thoracic Fracture

• Can lead to a loss of innervation of the intercostals muscles, leading to respiratory insufficiency

• “Spinal shock” can affect the thoracic area or higher.
Lumbar Spine Fracture

- Largest vertebrae
- Unsupported, so prone to injury
- Jackknifing injuries are the most common.
Humerus Fracture

- Vascular long bone
- May lose up to 750 mL of blood
- Mark the location of pulses that are found prior to transport with a skin marker.
Rib and Nasal Fractures

• Rib fracture
  – Rarely life threatening
  – May cause pneumothorax
  – Torn intercostal arteries can lead to significant blood loss or hemothorax.

• Nasal fracture
  – Cause concern for patency of the airway
Other Types of Extremity Trauma (1 of 2)

- **Dislocations**
  - Assume fracture also involved, consider emergency due to potential for neurovascular compromise

- **Subluxations**
  - Graded from I (sprain) to IV (dislocation)

- **Amputation**
  - Can be life threatening; locate missing part and transport
Other Types of Extremity Trauma (2 of 2)

- **Compartment syndrome**
  - Caused by burns, external compression, crushing injury; affects any extremity and buttocks; develops over period of hours

- **Crush injury and rhabdomyolysis**
  - Damage to sarcolemma from any cause resulting in influx of calcium and sodium; known as the smiling death
Management Techniques for Extremity Trauma

- Splinting
- Casting
- Reduction/realignment
- External fixation
- Internal fixation
Geriatric Trauma Considerations

- Presence of dentures, dental devices
- Kyphosis
- Reduced cough reflex
- Fragile nasal tissues
- Reduced vital capacity and tidal volume
- Capillary refill delays
- Medications, pacemakers
- Preexisting hypertension
Trauma During Pregnancy Considerations

- Maternal shock and death are the main causes of fetal demise.
- Pregnancy-related changes can mimic shock.
- Massive blood loss risk considerably increased with trauma to bony pelvis.
- Abruptio placenta causes 70% fetal demise in blunt trauma.
Flight Considerations

- Patients with severe trauma:
  - Are more likely to be transported by air instead of by ground
  - May not have time to wait for ground transport
Questions?