Chapter 22

Trauma Overview
For people younger than age 40, traumatic injuries are the leading cause of death in the United States.

- Traumatic emergencies occur as result of physical forces applied to the body.
- Medical emergencies occur from an illness or condition not caused by an outside force.
• The index of suspicion is your awareness and concern for potentially serious underlying and unseen injuries.
• Traumatic injury occurs when the body’s tissues are exposed to energy levels beyond their tolerance.

• The mechanism of injury (MOI) is the way traumatic injuries occur.
  – Describes the forces acting on the body that cause injury
Energy and Trauma (2 of 4)

• Three concepts of energy
  – Potential energy
  – Kinetic energy
  – Work

• Energy can be neither created nor destroyed, but can only be converted or transformed.
Energy and Trauma (3 of 4)

- Work is force acting over a distance.
- Work of a moving object is called kinetic energy.
  - Reflects the relationship between mass and velocity

Courtesy of Mark Woolcock
Potential energy is the product of mass, force of gravity, and height.

- Mostly associated with the energy of falling objects
Different MOIs produce many types of injuries.

Nonsignificant injuries
- Injury to an isolated body part
- A fall without the loss of consciousness
• Significant injuries:
  – Injury to more than one body system (multisystem trauma)
  – Falls from heights
  – Motor vehicle and motorcycle crashes
  – Car versus pedestrian
  – Gunshot wounds
  – Stabbings
Blunt and Penetrating Trauma

- Either type may occur from a variety of MOIs.
- Blunt trauma is the result of force to the body that causes injury without penetrating the soft tissues.
- Penetrating trauma causes injury by objects that primarily pierce and penetrate the surface of the body.
Blunt Trauma

- Results from an object making contact with the body
- Motor vehicle crashes and falls are the most common MOIs.
- Be alert to skin discoloration and pain.
- Maintain a high index of suspicion for hidden injuries.
Motor vehicle crashes are classified as:
- Frontal
- Rear-end
- Lateral
- Rollovers
- Rotational

The principal difference is the direction of the force of impact.
Vehicular Collisions (2 of 5)

- Car against another car, tree, or object
  - Damage to the car has an indirect effect on patient care.
  - By assessing the vehicle, you can often determine the MOI.

Source: © Jack Dagley Photography/Shutterstock, Inc.
Vehicular Collisions (3 of 5)

- Passenger against the interior of the car
  - Common passenger injuries include lower extremity fractures, flail chest, and head trauma.

Source: © Jack Dagley Photography/ShutterStock, Inc.
Vehicular Collisions (4 of 5)

- Passenger’s internal organs against solid structures of the body
  - Internal injuries may not be as obvious as external injuries, but are often the most life threatening.
Significant MOIs include the following findings:

- Death of an occupant in the vehicle
- Severe deformity of vehicle or intrusion into vehicle
- Altered mental status
- Ejection from the vehicle
Frontal Collisions (1 of 3)

• Evaluate supplemental restraint system
  – Seatbelts and air bags are effective in preventing a second collision inside the motor vehicle.
  – Air bags decrease the severity of deceleration injuries.
  – Air bags decrease injury to the chest, face, and head.

• Despite air bags, suspect injuries to:
  – Extremities (resulting from the second collision)
  – Internal organs (resulting from the third collision)
Children shorter than 4' 9" should ride in the rear seat.
- In a pickup truck or single-seated vehicle, the air bag should be turned off.

Remember that if the air bag did not inflate during the accident, it may deploy during extrication.
Frontal Collisions (3 of 3)

- Remember that supplemental restraint systems can cause harm whether they are used properly or improperly.
Rear-End Collisions (1 of 2)

- Known to cause whiplash-type injuries
  - Particularly in absence of a headrest

Source: © CrystalCraig/Dreamstime.com
Rear-End Collisions

- As the body is propelled forward, the head and neck are left behind.
- Acceleration-type injury to the brain is possible.
  - Third collision of the brain within the skull
Lateral Collisions (1 of 3)

- Side impacts
- Commonly called T-bone collisions

Source: © Dan Myers
• A vehicle struck from the side is usually struck above its center of gravity.
  – Begins to rock away from the side of impact
  – Results in the passenger sustaining a lateral whiplash injury
Lateral Collisions (3 of 3)

- If substantial intrusion into the passenger compartment, suspect:
  - Lateral chest and abdomen injuries on the side of the impact
  - Possible fractures of the lower extremities, pelvis, and ribs
  - Organ damage from the third collision
Rollover Crashes

- Large trucks and sport utility vehicles are prone.
- Injuries depend on whether the passenger was restrained.
- Most common life-threatening event is ejection or partial ejection of the passenger from the vehicle.
Rotational Collisions

- Spins are conceptually similar to rollovers.
- Opportunities for the vehicle to strike objects
  - Such as utility poles
• Injuries are often graphic and apparent.
• Can also be serious unseen injuries
• You should determine:
  – Speed of the vehicle
  – Whether the patient was thrown through the air
  – Whether the patient was struck and pulled under the vehicle
• Evaluate the vehicle that struck the patient for structural damage.
• ALS backup should be summoned for any patients who have sustained a significant MOI.
Car Versus Bicycle

- Evaluate like you would for a car-versus-pedestrian collision.
  - Also evaluate the damage to and position of the bicycle.
  - If the patient was wearing a helmet, inspect it for damage.

Source: © Robert Byron/Dreamstime.com
• Presume that the patient has sustained an injury to the spinal column, or spinal cord, until proven otherwise at the hospital.

• Spinal stabilization must be initiated and maintained during the encounter.
• Protection using:
  – Helmet
  – Leather or abrasion-resistant clothing
  – Boots

• Collisions usually occur against larger vehicles or stationary objects.
When you are assessing the scene, attention should be given to the:

- Deformity of the motorcycle
- Side of most damage
- Distance of skid in the road
- Extent and location of deformity in the helmet
• Head-on collision
  – Motorcycle strikes another object and stops its forward motion while the rider continues

• Angular collision
  – Motorcycle strikes an object at an angle so that the rider sustains direct crushing injuries to the lower extremity
• **Ejection**
  – Rider will travel at high speed until stopped by a stationary object, another vehicle, or road drag.

• **Controlled crash**
  – Technique used to separate the rider from the body of the motorcycle
• Injury potential depends on the height from which the patient fell.
  – More than 15' or 3 times the patient’s height is considered significant.
• Internal injuries pose the greatest threat to life.
Patients who fall and land on their feet may have less severe internal injuries.
  - Their legs may have absorbed much of the energy of the fall.
• Take the following factors into account:
  – The height of the fall
  – The type of surface struck
  – The part of the body that hit first, followed by the path of energy displacement
Penetrating Trauma (1 of 6)

- Second leading cause of trauma death after blunt trauma
  - May be caused accidentally by impalement
  - May be caused intentionally by a knife, ice pick, or other weapon
• With low-energy penetrations, injuries are caused by the sharp edges of the object moving through the body.
• Knives may have been deliberately moved around internally, causing more damage than the external wounds suggest.
Penetrating Trauma (3 of 6)

- Path of the projectile may not be easy to predict.
  - Bullet may ricochet within the body before exiting.
  - Path the projectile takes is its trajectory.
  - Fragmentation will increase damage.
Penetrating Trauma (4 of 6)

- Cavitation can result in serious injury to internal organs.
  - Temporary cavitation is caused by the acceleration of the bullet.
  - Permanent cavitation is caused by the bullet path.
Penetrating Trauma (5 of 6)

- Relationship between distance and severity of injury varies depending on the type of weapon involved.
  - Drag slows the projectile.
  - Energy available for a bullet to cause damage is more a function of its speed than its mass.
## Table 22-1 Recognizing Developing Problems in Trauma Patients

<table>
<thead>
<tr>
<th>Mechanism of Injury</th>
<th>Signs and Symptoms</th>
<th>Index of Suspicion</th>
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<tbody>
<tr>
<td>Blunt or penetrating trauma to the neck</td>
<td>Noisy or labored breathing, Swelling of the face or neck</td>
<td>Significant bleeding or foreign bodies in the upper or lower airway, causing obstruction</td>
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<tr>
<td>Significant chest wall blunt trauma from motor vehicle crashes, car-versus-pedestrian, and other crashes; penetrating trauma to the chest wall</td>
<td>Significant chest pain, Shortness of breath, Asymmetrical chest wall movement</td>
<td>Be alert for airway compromise</td>
</tr>
<tr>
<td>Any significant blunt force trauma from motor vehicle crashes or penetrating injury</td>
<td>Blunt or penetrating trauma to the neck, chest, abdomen, or groin, Blows to the head sustained during motor vehicle crashes, falls, or other incidents, producing loss of consciousness, altered mental status, inability to recall events, combativeness, or changes in speech patterns, Difficulty moving extremities; headache, especially with nausea and vomiting</td>
<td>Cardiac or pulmonary contusion, Pneumothorax or hemothorax, Broken ribs, causing breathing compromise</td>
</tr>
<tr>
<td>Any significant blunt force trauma, falls from a significant height, or penetrating trauma</td>
<td>Severe back and/or neck pain, history of difficulty moving extremities, loss of sensation or tingling in the extremities</td>
<td>Injuries in these regions may tear and cause damage to the large blood vessels located in these body areas, resulting in significant internal and external bleeding, Be alert to the possibility of bruising to the brain and bleeding in and around the brain tissue, which may cause the development of excess pressure inside the skull around the brain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Injury to the bones of the spinal column or to the spinal cord</td>
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</table>
Blast Injuries (1 of 7)

- Most common in war
- Also seen in:
  - Mines
  - Shipyards
  - Chemical plants
  - Terrorist attacks
Blast Injuries (2 of 7)

Primary Blast Injury
(injuries due to the blast wave itself)

Secondary Blast Injury
(injuries due to missiles being propelled by blast force)

Tertiary Blast Injury
(injuries due to impact with another object)
Blast Injuries (3 of 7)

- Primary blast injuries
  - Due entirely to the blast itself

- Secondary blast injuries
  - Damage to the body results from being struck by flying debris.

- Tertiary blast injuries
  - Victim is hurled by the force of the explosion.
Blast Injuries (4 of 7)

- Miscellaneous blast injuries
  - Burns from hot gases or fires started by the blast
  - Respiratory injury from inhaling toxic gases
  - Crush injury from the collapse of buildings
- Most patients will have some combination of the four types of injury.
Blast Injuries (5 of 7)

- Organs that contain air are most susceptible to pressure changes.
  - Middle ear
  - Lung
  - Gastrointestinal tract
- The ear is most sensitive to blast injuries.
• Pulmonary blast injuries result from short-range exposure to the detonation of explosives.

• Arterial air embolisms can produce:
  – Disturbances in vision
  – Changes in behavior and state of consciousness
  – Variety of other neurologic signs
• Solid organs are relatively protected from shock wave injury.
  – May be injured by secondary missiles or a hurled body
• Neurologic injuries and head trauma are the most common causes of death.
• Traumatic amputations are common.
Multisystem Trauma

- Involves more than one body system
  - Head and spinal trauma
  - Chest and abdominal trauma
  - Chest and multiple extremity trauma
- Alert medical control and transport rapidly.
Golden Principles of Prehospital Trauma Care (1 of 3)

• Your main priority is to ensure:
  – Your safety
  – Safety of your crew
  – Safety of the patient

• Determine the need for additional personnel or equipment.

• Evaluate the kinematics of the MOI.
Golden Principles of Prehospital Trauma Care (2 of 3)

• Identify and manage life threats.
• Then focus on patient care.
  – ABCs
  – Shock therapy
  – Backboard
• Transport immediately to the appropriate facility.
Golden Principles of Prehospital Trauma Care (3 of 3)

- Definitive care requires surgical intervention.
  - On-scene time should be limited to 10 minutes or less.
- Obtain a SAMPLE history and complete a secondary assessment.
- Consider ALS intercept and/or medical transportation.
Patient Assessment

- Patient assessment consists of:
  - Scene size-up
  - Primary assessment
  - History taking
  - Secondary assessment
  - Reassessment

- Perform a rapid full-body scan or rapid head-to-toe examination.
Injuries to the Head

- Disability and unseen injury to the brain may occur.
- Bleeding or swelling inside the skull is often life threatening.
- Include frequent neurologic examinations in your assessment.
- Some patients will not have obvious signs or symptoms.
Injuries to the Neck and Throat

- Area of serious or deadly injuries.
- Airway problems may result.
- Look for DCAP-BTLS in the neck region.
- Swelling may prevent blood flow to the brain.
- Penetrating injury may result in air embolism.
- Crushing injury may cause the cartilages of the upper airway and larynx to fracture.
Injuries to the Chest (1 of 2)

- Chest contains heart, lungs, and large blood vessels.
- Many life-threatening injuries may occur to the chest.
  - Broken ribs may hinder breathing.
  - Heart may be bruised.
  - Large vessels may be torn.
A penetration or perforation of the integrity of the chest is called an open chest wound.
- Assess the chest region every 5 minutes.
- Assessment should include DCAP-BTLS, lung sounds, and chest rise and fall.
Injuries to the Abdomen

- Abdomen contains vital organs that require a very high amount of blood flow.
- Solid organs include the liver, spleen, pancreas, and kidneys.
- Hollow organs include the stomach, large and small intestines, and urinary bladder.
Injuries to the Abdomen

- Solid organs may tear, lacerate, or fracture.
- Hollow organs may rupture and leak acidlike digestive chemicals.
- The rupture of large blood vessels can cause serious unseen bleeding.
Scene time

- Survival of critically injured trauma patients is time dependent.
- Critically injured patient:
  - Dangerous MOI
  - Decreased level of consciousness
  - Threats to airway, breathing, or circulation
• **Type of transport**
  
  – Ground EMS units are staffed by EMTs and paramedics.
  
  – Air EMS units or critical care transport units are staffed by critical care nurses and paramedics.
• Destination selection
  – Level I facility
    • Serves large cities or heavily populated areas
    • Provides every aspect of trauma care
    • Usually university-based hospitals
  – Level II facility
    • Located in less population-dense areas
    • Provides initial definitive care
• Destination selection (cont’d)
  – Level III facility
    • Provides assessment, resuscitation, emergency care, and stabilization
    • Transfers patients to Level I or Level II facility when necessary
  – Level IV facility
    • Found in remote outlying areas
    • Provides advanced trauma life support
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<th>Level</th>
<th>Definition</th>
<th>Key Elements</th>
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</table>
| Level I | A comprehensive regional resource that is a tertiary care facility; capable of providing total care for every aspect of injury—from prevention through rehabilitation | 1. 24-hour in-house coverage by general surgeons  
2. Availability of care in specialties such as orthopaedic surgery, neurosurgery, anesthesia, emergency medicine, radiology, internal medicine, and critical care  
3. Should also include cardiac, hand, pediatric, and microvascular surgery and hemodialysis  
4. Provides leadership in prevention, public education, and continuing education of trauma team members  
5. Committed to continued improvement through a comprehensive quality assessment program and organized research to help direct new innovations in trauma care |
| Level II | Able to initiate definitive care for all injured patients | 1. 24-hour immediate coverage by general surgeons  
2. Availability of orthopaedic surgery, neurosurgery, anesthesia, emergency medicine, radiology, and critical care  
3. Tertiary care needs such as cardiac surgery, hemodialysis, and microvascular surgery may be referred to a Level I trauma center  
4. Committed to trauma prevention and continuing education of trauma team members  
5. Provides continued improvement in trauma care through a comprehensive quality assessment program |
| Level III | Ability to provide prompt assessment, resuscitation, and stabilization of injured patients and emergency operations | 1. 24-hour immediate coverage by emergency medicine physicians and prompt availability of general surgeons and anesthesiologists  
2. Program dedicated to continued improvement in trauma care through a comprehensive quality assessment program  
3. Has developed transfer agreements for patients requiring more comprehensive care at a Level I or Level II trauma center  
4. Committed to continuing education of nursing and allied health personnel or the trauma team  
5. Must be involved with prevention and have an active outreach program for its referring communities |
| Level IV | Ability to provide advanced trauma life support (ATLS) before transfer of patients to a higher level trauma center | 1. Include basic emergency department facilities to implement ATLS protocols and 24-hour laboratory coverage  
2. Transfer to higher level trauma centers follows the guidelines outlined in formal transfer agreements  
3. Committed to continued improvement of these trauma care activities through a formal quality assessment program  
4. Involved in prevention, outreach, and education within its community |
The American College of Surgeons’ Committee on Trauma provides criteria for Level I and II trauma patient classifications.

### Table 22-3: American College of Surgeons Criteria for a Level I Patient

- Confirmed blood pressure of less than 90 mm Hg at any time in adults, and age-specific hypotension in children
- Respiratory compromise, obstruction, and/or intubation
- Receiving blood to maintain vital signs
- Emergency physician’s discretion
- Glasgow Coma Scale (GCS) score of less than or equal to 8 with mechanism attributed to trauma
- Gunshot wound to the abdomen, neck, or chest
### Table 22-4 American College of Surgeons Recommendations for a Level II Patient

| Patient characteristic/condition indicators | 1. Glasgow Coma Scale (GCS) score of less than 14 when associated with trauma  
2. Respiratory rate of less than 10 or more than 29 breaths/min (less than 20 breaths/min in infant younger than 1 year of age) 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 vehicle crash  
|  | ■ Initial speed of greater than 40 mph  
|  | ■ Major vehicle deformity  
|  | ■ Intrusion into the passenger compartment  
2. Ejection from the vehicle  
3. Death in same passenger compartment  
4. Extrication time of greater than 20 minutes  
5. Falls of greater than 20' or significant falls in children or elderly  
6. Vehicle rollover  
7. Car-versus-pedestrian or car-versus-bicycle impact of greater than 5 mph  
8. All-terrain vehicle (ATV) or motorcycle crash of greater than 20 mph or separation of rider from ATV or motorcycle |
| Pediatric indicators include:  
1. Falls of greater than 10' without loss of consciousness  
2. Falls of less than 10' with loss of consciousness  
3. Medium- to high-speed vehicle collision (≥ 25 mph) |
| Consider Level II classification with the following preexisting conditions | 1. Age younger than 5 years or older than 55 years  
2. Cardiac disease, respiratory disease  
3. Type 1 diabetes mellitus, cirrhosis of the liver, morbid obesity  
4. Pregnancy  
5. Immunocompromised patients  
6. Patients with a bleeding disorder or on anticoagulants |
Management: Transport and Destination (8 of 8)

- Special considerations
  - Remain calm.
  - Complete an organized assessment.
  - Correct life-threatening injuries.
  - Do no harm.
  - Never hesitate to contact ALS backup or medical control for guidance.
• Determine the mechanism of injury (MOI) as quickly as possible.
• Three concepts of energy are typically associated with injury: potential energy, kinetic energy, and work.
• Traumatic injuries can be described as blunt trauma or penetrating trauma.
Motor vehicle crashes are classified traditionally as frontal (head-on), lateral (T-bone), rear-end, rotational (spins), and rollovers.
In every crash three collisions occur:

- Collision of the vehicle against some type of object
- Collision of the passenger against the interior of the vehicle
- Collision of the passenger’s internal organs against the solid structures of the body
• Maintain a high index of suspicion for serious injury in the patient who has:
  – Been involved in a motor vehicle collision
  – Been involved in a motor vehicle collision with significant damage to the vehicle
  – Fallen from a significant height
  – Sustained penetrating trauma to the body
People who are injured in explosions may have injuries that are classified as primary blast injuries, secondary blast injuries, tertiary blast injuries, and/or miscellaneous blast injuries.
A patient who has sustained a significant MOI and is considered to be in serious or critical condition should receive a full-body examination.

A patient who has sustained a nonsignificant MOI should receive an assessment focused on the chief complaint.
Caring for victims of traumatic injuries requires the EMT to have a solid understanding of the trauma system in the United States.