Trauma Overview

First Reported Traffic Death
- Occurred: August 17, 1896
- Place: Crystal Palace, London, UK
- Bridgett Driscoll 44 years old
- Speed: 4 mph Witnesses state that the vehicle that hit her was traveling at a "tremendous speed".
- Coroner Quote: "I trust that this sort of nonsense will never happen again."

Trauma
- Injury Caused by Application of force to the body.
- Mechanical (Kinetic) is the most common agent of injury
- Leading cause of death of people under 45
- Fourth leading cause of death for all age groups.
- Over 60 million injuries annually
  - 30 million require medical care
  - 9 million are disabling injuries
- Cost = $210 billion each year

Why do we need to know the mechanism?
- Provides clues for possibly occult injuries
- Allows better management for patient’s injuries
- Provides clues to possible severity of injuries
Predicting Injury

In a 50 mph (80 km/h) MVC, what types of injuries would occur if the patient were to strike the windshield?

Energy and Trauma
- Work
  - Force acting over distance
- Kinetic energy
  - Energy of moving object
- Potential energy
  - Product of weight, gravity, and height

Three Ways Motion Causes Injury
- Forward Deceleration
- Vertical Deceleration
- Projectile Penetrations
Types of Trauma

Blunt Trauma
Penetrating Trauma

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

Newton’s Second Law
Force (F) = Mass (M) X Acceleration (A)
F=MA

Newton’s Third Law
For every action, there is an equal and opposite reaction.

Velocity versus Mass
- 150 lb (68 kg) person traveling at 30 mph (48 km/h) = 67,500 (78,336) KE units
- 180 lb (82 kg) person traveling at 30 mph (48 km/h) = 81,000 (94,464) KE units
- 150 lb (68 kg) person traveling at 40 mph (64 km/h) = 120,000 (139,264) KE units

What is more important velocity or mass?
Law of Conservation of Energy

- Energy cannot be created or destroyed
- Energy can change forms and can be transferred

Can you give an example?

How does the law of conservation of energy pertain to trauma?

Can you give some examples?

The Three Collision Theory

- Impact Points Within the Passenger Compartment
  - Windshield
  - Steering Wheel
  - Dashboard
  - Seatbelt
  - Airbags
  - Other Components

Weapons in a Motor Vehicle Accident
Clues to Injury

- Vehicle Deformation
- Damage to Interior Structures
- Injury Patterns of the Victim

Ring of Injuries

- Face
- Neck
- Chest
- Abdomen

Types of Accidents

- Motor Vehicle
  - Rear End Collision
  - Lateral Impact
  - Rollover Crash
  - Head on Collision
- Motorcycle Collision
- Pedestrian vs. Vehicle
- Recreational Vehicles
- Tractor Accidents
What type of injury patterns might you see in a frontal impact?

What injuries would you expect with an up-and-over pathway?

What injuries would you expect with a down-and-under pathway?

What types of injuries would you expect?
Rotational Impact

What types of injuries would you expect?

Rollover

What injury patterns might you see following this crash?

Motorcycle Crashes

Mandatory helmet laws have been associated with up to 300% fewer head injuries and deaths.

Frontal Impact/Ejection

How many impacts typically occur?
What types of injuries would you expect to see?

Lateral Impact

How many impacts typically occur?
What types of injuries would you expect to see?
Pedestrian versus Motor Vehicle

What injuries would you expect?

Pedestrian versus Motor Vehicle

How are injury patterns different with a child?

Mechanisms of a MVA
Falls
- Adults tend to land feet first
- At Risk Groups:
  - Small Children tend to Strike Head First
  - Adults:
    - Occupational
    - Elderly & Trivial Falls

Factors Determining Injuries
- Distance of Fall
- Body Part Impacted
- Type of Surface Struck by Body
Penetrating Trauma
- Second Leading Cause of Death in US
- Safety Risk for Rescue Personnel
- Maybe Accidental or Intentional

Stab Wounds
- Factors Affecting Severity:
  - Anatomical Site
  - Length of Knife Blade
  - Angle of Penetration
- DO NOT REMOVE IMPALED OBJECTS

Gunshot Wounds
- Type of Weapon
- Caliber
- Distance From Victim
- Type of Bullet

Kinetic Energy Theory
- $KE = \frac{1}{2} \text{Mass} \times \text{Velocity}^2$

Types of Weapons:
- High Velocity=>2000 ft per second
- Low Velocity=<2000 ft per second

Medium Velocity
High Velocity

Ballistics Cavitation

Deformation
- Creates increased cross section.
- Promotes transfer of kinetic energy.
- Geometry dictates that...
  - 2-fold increase in diameter results in a four-fold increase in area.
  - This process is (in theory) promoted by partial jacket design.

Fragmentation
- Increases surface area
- Increases efficiency of kinetic energy transfer
- Multiple projectiles

Fragmentation
- Significant wounding potential
- Requires high velocity to reliably occur
- Particularly destructive when combined with concomitant cavitation wave
The Tumble Effect

- Projectiles travel through a dense media with their center of gravity forward.
- Tumble is an inevitable result of rifle projectile design.

Stippling

- Deposition of gunpowder in a “tattooing” pattern around the entrance wound
- Usually indicative of close range
  - Roughly 3 to 8 inches

Fouling

- The concentric deposition of gunpowder at the entrance site
- Indicative of contact or immediate proximity of the weapon

Shotgun Wounds

- Factors-
  - Size of Pellets
  - Amount of Powder
  - Choke
  - Distance
- At close range High Energy Delivered
- Pellet Velocity Decreases with Distance

Shotgun-Barrel Choke

<table>
<thead>
<tr>
<th>Choke</th>
<th>Constriction(1/1000)</th>
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</thead>
<tbody>
<tr>
<td>Cylinder bore</td>
<td>None</td>
</tr>
<tr>
<td>Improved</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Modified</td>
<td>20</td>
</tr>
<tr>
<td>Improved Modified</td>
<td>30</td>
</tr>
<tr>
<td>Full choke</td>
<td>40</td>
</tr>
</tbody>
</table>

Shotgun Shell Construction

- Standard weight of shot
- Wadding separates powder from shot
- Shot usually contained by plastic collar
Shotgun – Estimating Range
- Wadding in the wound implies very close range.

Low-Velocity Wounds
- Objects
  - Knives, ice-picks, arrows
  - Flying objects or debris
- Injury limited to tissue impacted
  - Object pathway
  - Object twisting or moved
  - Oblique angle
- Attacker Characteristics
  - Males: outward and crosswise
  - Females: overhand and downward

Bullet Proof Vests
- Stop Projectile Penetration
- Victim Still Receives ENERGY

Blast Injuries
- Always remember your safety
- Three Possible Times for Injury to Occur:
  - Primary
  - Secondary
  - Tertiary
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

- 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

- 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

- 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.

**Injuries to the Neck and Throat**

- 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**

- 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.

**Injuries to the Chest**

- 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.

Management: Transport and Destination

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

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

Table 22.2 Key Elements for Trauma Centers

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Key Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I</td>
<td>��具有全面的创伤救治能力，能够对严重创伤进行立即、全面的治疗。</td>
<td>1. 创伤中心，具备创伤救治能力。2. 创伤的全面治疗。</td>
</tr>
<tr>
<td>Level II</td>
<td>中心能够对严重创伤进行初步治疗，并向创伤中心转送。</td>
<td>1. 中心能够对严重创伤进行初步治疗。2. 创伤的初步治疗。</td>
</tr>
<tr>
<td>Level III</td>
<td>中心能够对严重创伤进行再次治疗，并向创伤中心转送。</td>
<td>1. 中心能够对严重创伤进行再次治疗。2. 国内的治疗。</td>
</tr>
<tr>
<td>Level IV</td>
<td>中心能够对严重创伤进行监测和治疗。</td>
<td>1. 中心能够对严重创伤进行监测和治疗。2. 国内的治疗。</td>
</tr>
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</table>
Management: Transport and Destination

**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

Management: Transport and Destination

- **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.

Questions?