Spine & Nervous System Trauma

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http://www.youtube.com/watch?v=g2Tdp_7q3N4
Introduction & Statistics

• 12,000-14,000 traumatic spinal cord injuries (SCI’s) each year
• 4% - 5% of all head injuries are associated with C1-C3 fractures
• 80% of SCI’s are male (41% 16-30 yrs old)

Spine & Vertebral Trauma

- MVC's 49%
- Falls 21%
- Violence 19%
- Sports 11%
Types of Injuries

- **Blunt** (MVC, Falls, Violence, Sports)
  - Acceleration
  - Deceleration
  - Combination

- **Penetrating**
  - Gunshot wound
  - Stab wound
  - Shrapnel
Mechanism of Injury

- Hyperextension – Struck from rear, diving board, fall
- Hyperflexion – Head on crash
- Rotational – Spinning
- Compression – Diving (p. 1183)
- Axial loading – Jumping, falls from heights or diving
- Lateral bending – T-boned
- Distraction – Sudden stop
- Incorrectly applied safety restraints –
  - Submarine
  - Sudden flexion
Mechanism of Spinal Cord Injuries
Classification of Spinal Injuries

- Sprains
- Strains
- Fractures
- Dislocations
- Sacral & coccygeal fractures
- Spinal cord injuries (SCIs)
Sprains & Strains

• Hyperflexion Sprain
  – Partial dislocation or subluxation of vertebral joints (posterior ligament tears)

• Hyperextension Strain
  – Low speed rear-end crash = whiplash

• Signs & Symptoms
  – Muscle spasms of neck or back muscles
  – Nonradiating aching soreness
  – Bony deformity - Subluxation

• Treatment
  – Cervical collar, heat, & analgesics
Fractures & Dislocations

- Most Frequently Injured Areas
  - C5-C7
  - C1-C2 Atlanto-occipital dislocation
    Jefferson fx. Ondontoid or Hangman’s fx.
  - T12-L2 Chance fxs

- Types of Fractures
  - Simple – **Stable/aligned** – Linear spinous or transverse process, facets or pedicle fx.
  - Wedge/Compression – **Stable** - Stretch posterior ligaments (Falls – T12-L1)
  - Teardrop/Dislocations – **Unstable** – Anterior/inferior corner pushed upwards
  - Comminuted Burst Fx – **Unstable**
Sacral & Coccygeal Fractures

- S1 & S2 fractures are common
  - Loss of sensation & motor function to the perianal area (Bladder sphincters)
- Tailbone fractures - falls
Complete Spinal Cord Injuries

**Complete Injury/Lesion – Transection**
- Spinal fracture-dislocation
- Complete loss of pain, pressure, proprioception
- Motor paralysis below the level of the injury
- Autonomic disfuntion
  - Bradycardia
  - Hypotension
  - Priapism-erect penis does not return to flaccid state
  - Unable to sweat or shiver
  - Pokilothermy – Loss of thermal regulation
  - Loss of bowels & bladder control
Incomplete SCIs

• **Central Cord Syndrome**
  – Paralysis of the arms
  – Sacral sparing – sensory & motor function

• **Anterior Cord Syndrome**
  – ↓ sensation of pain & temperature below injury
  – (+) light touch & proprioception
  – Paralysis

• **Brown-Séquard Syndrome**
  – Weakness in the extremities on the same side of injury
  – Loss of temperature & pain on the opposite side of injury

• **Posterior Cord Syndrome**
  – Motor function intact
  – Loss of fine touch & pressure, proprioception, & vibration below the level of the injury
1° Neurological Deficits

- Concussion
- Contusions
- Transection
- Structural damage of the vertebrae or spinal column
- Interruption of the blood supply
- Inadequate ventilation/O₂
  - C3 & above loss of phrenic innervation
  - C3-C5 = Loss if diaphragmatic innervation
  - C6-T8 = Loss of intercostal function
2° Injury to the Spinal Cord

- Shock
  - Hypovolemic
  - Neurogenic
    - Hot skin, slow HR, low BP
- Hypoxia
- Biochemical
  - Edema
  - Necrosis
Vertebral & SCI Assessment

• Life Threats – ABC’s with immobilization
• 100% O₂, IV’s
• History & MOI
• c/o neck or back pain
• Spontaneous movement – motor function & strength in 4 extremities (T1, S1-S2, L5)
• Alteration in sensation – weakness, numbness, light touch (more than 1 tract)
• Loss of bowel or bladder control
Nerve Tracts
## Dermatome Correlation

<table>
<thead>
<tr>
<th>Nerve Root</th>
<th>Motor</th>
<th>Sensory</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3, C4</td>
<td>Shoulder shrug</td>
<td>Top of shoulder</td>
</tr>
<tr>
<td>C3-C5</td>
<td>Diaphragm</td>
<td>Top of shoulder</td>
</tr>
<tr>
<td>C5, C6</td>
<td>Elbow Flexion</td>
<td>Thumb</td>
</tr>
<tr>
<td>C7</td>
<td>Elbow Extension</td>
<td>Middle finger</td>
</tr>
<tr>
<td>C8, T1</td>
<td>Finger abduction &amp; adduction</td>
<td>Little finger</td>
</tr>
<tr>
<td>T4</td>
<td>Nipple</td>
<td></td>
</tr>
</tbody>
</table>
## Dermatome Correlation

<table>
<thead>
<tr>
<th>Dermatome (Spinal Nerve Roots)</th>
<th>Sensory Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>T10</td>
<td>Umbilicus</td>
</tr>
<tr>
<td>L1, L2</td>
<td>Hip flexion</td>
</tr>
<tr>
<td>L3, L4</td>
<td>Quadriceps</td>
</tr>
<tr>
<td>LS</td>
<td>Great toe/foot dorsiflexion</td>
</tr>
<tr>
<td>S1</td>
<td>Knee flexion</td>
</tr>
<tr>
<td>S1, S2</td>
<td>Foot plantar flexion</td>
</tr>
<tr>
<td>S2-S4</td>
<td>Anal sphincter tone</td>
</tr>
</tbody>
</table>

- **Inguinal crease**
- **Medial thigh/calf**
- **Lateral calf**
- **Lateral foot**
- **Perianal**
Reflex Assessment

- *** Rarely evaluated prehospital
- May indicate autonomic nerve injury
  - Temperature control
  - Hypotension
  - Bradycardia
  - Priapism
  - Babinski sign - An up-turning or extensor plantar response (dorsiflexion of the great toe with or without fanning out of the toes)
Neurogenic Spinal Shock

Temporary Loss of sensory, motor & reflex function
Below the level of injury
Flaccidity & Loss of reflexes
Duration is variable hours to weeks

Hypotensive, bradycardic, warm skin
Can’t sweat below level of injury
Temporary – Usually less than 72 hours
Visual Assessment

• Diaphragmatic breathing
• Intercostal muscle function
• Body position
  – Holdup position – C6 injury with arms flexed at elbows and wrists
  – Lying on face after fall – C2 (Ondontoid Fx.)
Palpation

- Step-off deformity
- Point tenderness over the vertebrae
- Crepitus over the vertebrae
- Muscle spasms
Cervical, Brachial & Lumbar Plexus Injuries

• Interlacing network of nerve fibers
• Injuries by stretching, contusion, compression, transection
  – C3-C5 = Cervical Plexus
  – C5-C8 & T1 = Brachial Plexus – Motor to arm, hand, wrist
  – L5-S4 = Lumbar Plexus – Posterior lower body
Associated Injuries

• Drowning/near drowning
  – Surfing
  – Diving
  – Water or jet skiing
• Distracting injuries
  – Other systems
Concurrent Injuries

- Closed head injuries
- Facial injuries
- Long bone fractures
- Thoracic injuries
- Abdominal injuries
Pre-Hospital Concerns

- Immobilization with rigid cervical collar and Cervical Immobilization Devices (CID’s)
Management of Vertebral or SCIs

- Prevent further injury with immobilization
- Long board
- Complete spinal immobilization from initial assessment to destination
- Head & neck in a neutral position unless contraindicated
Immobilization Concerns

• **No** more tape & sandbags
• **Do not** remove the helmet in the field
• Faster the time to definitive care in a facility for SCI’s the better the outcome