Traumatic spine injury

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13 year old gymnast

- Fell into pit on landing, striking vertex of head.
- Presented with neck pain.
- Initial x-ray normal
- What should be done?
5 days later, noted to have left C7 root weakness.
MRI confirms subluxation
CT reveals fracture of facet

Axial CT at C6

Midline sagittal CT recon

Sagittal CT at lateral mass
Epidemiology

• Incidence of SCI
  – 29-50 SCI per million population per year
  – Approximately 10,000/year in the US
• Prevalence
  – 200,000 people with SCI in the US.
• Median age 25 (children <16 only 5% of SCI)
• M:F ratio is 4:1
Epidemiology of Cervical Spine Injuries in Athletes

- Depending on the series, the incidence and severity of injury is highly variable.
  - 32% of college football recruits sustained moderate cervical injuries in high school (Jama, 1976). Correlates with years of experience and linebacker or defensive halfback position.
  - Catastrophic injury
    - 1976: 2.5 per 100,000
    - 1991: 0.5 per 100,000
  - 2-10% of significant injuries to the cervical spine are sports-related (Neurosurgery, 1991/1996).
Causes of injury

• Mechanisms:
  – <10 y/o--Falls, MVA’s
  – >10 y/o--MVA’s, falls, sports, violence
  – (MVA 45%, falls 22%, sports 14%, violence 14%)
## Injury Levels

<table>
<thead>
<tr>
<th>Location</th>
<th>Incidence</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical</td>
<td>52%</td>
<td>40%</td>
</tr>
<tr>
<td>Thoracic</td>
<td>29%</td>
<td>30%</td>
</tr>
<tr>
<td>Lumbar</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Sacral</td>
<td>4%</td>
<td>6%</td>
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Biomechanics

• Different spinal injury levels by age:
  – 0 to 8 years old:
    • 80% cervical spine
    • 2/3 upper cervical spine
  – >9 years old:
    • 50% cervical spine
    • ½ upper cervical spine
Mechanisms of Spine Injury
Mechanisms of spine injury

1. Flexion
   • wedge fracture
   • facet dislocation

2. Extension
   • Lamina, pars & spinous process fractures

3. Compression
   • burst fracture

4. Translation
   • Chance fracture
Types of athletic cervical spine injuries

• Nerve root and brachial plexus
• Cervical sprain
• Transient quadriplegia
• Intervertebral disk lesions
• Fractures and dislocations
Nerve root and brachial plexus neuropraxia

• Commonly referred to as “stingers” or “burners”.
• Affects roughly 50% of football players.
• Symptoms include unilateral arm pain and weakness, and usually resolve within 24 hours.
• Players restricted until pain resolved and strength recovered.
Mechanisms of “burners”

- A) Traction on nerve roots or brachial plexus
- B) Direct blow to plexus.
- C) Trauma to nerve roots
Cervical Sprain/Ligamentous Injury

• Generally presents with neck pain and decreased range of motion.
• Potential for instability.
  – Cervical immobilization is required.
• Initial radiographic studies include static neck films, followed by flexion/extension films if normal. MRI may also help demonstrate ligamentous injury.
• If all studies are normal, athlete may return to play when symptoms have resolved. Evidence of instability requires individualized treatment plan.
17 year old s/p football injury
One week later
Intervertebral disk lesions

• Herniated disks are common with repetitive axial loading injuries.
• Treatment is frequently non-surgical.
• Most athletes can return to play whether or not they have had surgery.
36 year old female athlete presents with arm pain.

T2 weighted sagittal MRI scan at onset of symptoms revealing C5/6 disk herniation.

Followup T2 weighted sagittal MRI with resolution of herniated disk. Return to play allowed.
Transient quadriplegia

- Also referred to as neuropraxia of the cervical cord.
- Variations include the “burning hands” syndrome.
- Symptoms include bilateral burning pain, tingling, numbness, and motor loss
  - usually resolves within 10-15 minutes,
  - may last up to 48 hours.
- After a single episode, athlete may return to play if there are no anatomic contraindications
SCIWORA

– Spinal cord injury without radiographic abnormality
– Ligamentous laxity and cervical hypermobility lead to stretch injury of the cord. Most prevalent in children.
Possible Mechanism for SCIWORA

- Injury to spinal cord may occur during extremes of flexion/extension.
- Mechanism involves pinching the cord between the vertebral body and adjacent lamina, with no obvious bony or ligamentous disruption.

Cervical Stenosis

• Functional stenosis
  – Decrease in space available for spinal cord based on MRI, CT, or myelographic criteria
Spear tackler’s spine

• Clinical entity including
  – Developmental stenosis of the cervical spine.
  – Loss of the normal cervical lordosis.
  – Pre-existing traumatic x-ray abnormalities.
  – Documentation of using spear tackling techniques.

• Many authors consider this an absolute contraindication to resuming contact sports.
When assuming the spear tackling posture, cervical lordosis is lost.

Loss of lordosis leads to direct transmission of axial loading forces to the vertebral bodies.
Fractures and dislocations

• Most common cause of severe spinal cord injury is fracture-dislocation.
• In sports, the speed and size of many athletes have exceeded the strength of the musculo-skeletal system
  – well trained professionals sustain the greatest proportion of these injuries.
Vascular injuries
Vertebral artery dissection

- Occluded right
- Patent left
Symptoms after Arterial Injury

Carotid artery
- Language difficulty
- weakness or numbness of one side of body
- Horner’s syndrome:
  - ptosis (droopy eyelid)
  - miosis (constricted pupil)

Vertebral artery
- occipital headache
- dizziness, nausea, vomiting, incoordination
- cranial nerve dysfunction
  - tinnitus, double vision, difficulty swallowing
Spinal cord injury
Classification of Spinal Cord Injury

• ASIA
  – American Spinal Injury Association
  • Standards for Neurological and Functional Classifications of Spinal Cord Injury.

**ASIA IMPAIRMENT SCALE**

- **A = Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.
- **B = Incomplete:** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- **C = Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- **D = Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- **E = Normal:** motor and sensory function are normal

**CLINICAL SYNDROMES**

- Central Cord
- Brown-Sequard
- Anterior Cord
- Conus Medullaris
- Cauda Equina
ASIA Criteria

- Define both sensory and motor points felt to be consistent and reliable among examiners.
  - Sensory exam consists of pain/temperature and light touch sensation for 28 dermatomes
  - Motor exam is ten muscle groups
ASIA Motor Criteria

• Upper Extremity
  – Elbow Flexors
  – Wrist Extensors
  – Elbow extensors
  – Finger Flexors
  – Finger Abductors

• Lower Extremity
  – Hip Flexors
  – Knee Extensors
  – Ankle dorsiflexors
  – Long toe extensors
  – Ankle plantar flexors
Clearance of the cervical spine

- In most series, 2-4% of blunt trauma patients have cervical spine injury.
- 0.7% of blunt trauma patients have spinal cord injury without fracture.
- Those patients with cranial and facial injuries are not at higher risk for spine injury than other victims of blunt trauma.
Guidelines for the clearance of the cervical spine

• Currently no evidence based standard exists. However, many guidelines and practice parameters for the clearance of cervical spine injuries have been established.

• The challenge for any clearance protocol is detection of patients with ligamentous injury, but no clear evidence of spinal cord injury or fracture.

• Reported rates of missed cervical spine injury are very low (0.01%).
Factors to consider in assessing risk of cervical spine injury in blunt trauma victims

- Mechanism of injury
- Presence of distracting injury
- Level of consciousness
- Neck pain
- Neurological deficit
<table>
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<th>Guidelines proposed by EAST</th>
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<tr>
<td><strong>Awake, alert, no neck pain</strong></td>
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<tr>
<td><strong>Presence of distracting injury</strong></td>
</tr>
<tr>
<td><strong>Altered level of consciousness</strong></td>
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<td><strong>Mechanism of injury</strong></td>
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NEXUS
National Emergency X-ray Utilization Study

• Assessed 5 Criteria
  • Cervical tenderness
  • Intoxication
  • Altered LOC
  • Neurological deficit
  • Distracting Injury

• If patient has none of the above, they require no radiographic clearance.
Timing of cervical spine clearance

• Evaluation and management of life threatening injuries should take priority over cervical spine clearance.
X-rays Clearance
X-rays Clearance
MRI with spinal contusion
Acute Management of SCI

• Main structural concepts of management
  – Immobilization/stabilization of spine
  – Decompression of neural elements
Acute Management of SCI

- Immobilization
  - Rigid cervical collar
  - Backboard
  - Tape or straps
  - Pediatric differences that must be considered include cranio-cervical disproportion and level of cooperation
Acute Management of SCI

• IV Fluids
  – Maintenance rate
  – Boluses as indicated
  – Avoid dextrose

• Steroids
  – Methylprednisolone (30mg/kg load followed by 5.4mg/kg/hr x23hr)
  – 24 vs. 48 hours (Bracken, et al, 1997)

• Hypothermia
Acute Management of SCI

• Vasopressors to treat “spinal shock”
  – Neurogenic shock—hypotension due to impaired sympathetic pathways
    • loss of ability to mount tachycardic response
    • Inability to regulate blood vessel constriction
  – Spinal shock-- acute and transient flaccidity and loss of reflexes after severe spinal injury (can cause false appearance of complete SCI)
Chronic Care Issues-
post traumatic syrinx
Summary

• Spinal cord injury is one of the most catastrophic of all traumatic injuries.

• Currently available medical treatments for spinal cord injuries are largely ineffective. Immobilization and decompression are main therapies.

• Attention to prevention is crucial, especially in light of the disease severity.