Disclosures

• Financial: none
• Positions of influence: Board of Governors, American Academy of Physical Medicine and Rehabilitation (AAPMR)
Stingers & Transient Quadriplegia

- Assessment
- Epidemiology
- Anatomy
- Mechanisms of injury
- Prevention
- Rehabilitation
- Return to Play
A Rose by any Other Name

- Stingers
- Burners
- Transient brachial plexopathy
- Brachial stretch or traction injury
- Nerve root compression
- Cervical pinch syndrome
Assess

1. Note exact time of injury. Management decisions are based on duration of symptoms.

2. Assess loss of consciousness. Management of unresponsive athletes should follow the ABCs of trauma care (i.e., check airway, breathing, and circulation).

3. Assess peripheral strength and sensation without moving the athlete’s head or neck.
Examine

4. Palpate the neck for asymmetric spasm or tenderness at the spine.

5. Assess isometric neck strength without moving the athlete’s head or neck.

6. Assess active range of motion at the neck.

7. Perform axial compression and Spurling test. If negative, athlete may be moved.
8. Assess recent memory and postural instability.

9. Inquire about symptoms such as headache, nausea, dizziness, or blurred vision.
On-field Evaluation

• **Spinal clearance is necessary**
  - Rule out SCI
  - Immobilize and transport if necessary

• **Red Flags of injury**
  - Bilateral upper (or lower) extremity symptoms
  - Persistent neck pain
    - Point tenderness
    - Stiffness
  - Spinal deformity
  - Fear of moving the head
Epidemiology

- Majority of stingers are reported in football
- 52% of college football players experienced a stinger in single season
- 65-70% of college football players have had a stinger in 4 year career
- Recurrence rate up to 85%

Sallis, 1992
NCAA guidelines, 2011-12
Sallis, 1991
Safran, 2004
SCI Decreasing Risk

- Incidence of *cervical spinal cord injury in football* per 100,000 participants

<table>
<thead>
<tr>
<th>Year</th>
<th>High School</th>
<th>College</th>
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<td>10.66</td>
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<tr>
<td>1977</td>
<td>1.3</td>
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<tr>
<td>1989 to 2002</td>
<td>0.5</td>
<td>0.82</td>
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<tr>
<td>2006 to 2010</td>
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- A rule change in 1976 banning spear tackling led to an immediate and sustained drop in the rates of cervical spinal cord injury in football.
Cervical nerve roots

- 8 pairs of cervical roots
- Rootlets off spinal cord
- Segmental dorsal and ventral roots from spinal cord
  - Ventral=motor
  - Dorsal=sensory
- Spinal nerve (located in the foramen)
Brachial plexus

- **Roots**
  - C5-T1

- **Trunks**
  - Upper, middle, lower

- **Divisions**

- **Cords**
  - Lateral, posterior, medial

- **Terminal nerves**
  - Median, Ulnar, Radial, MC
Presentation

• Unilateral shoulder or arm pain
  – Dysesthesias/paresthesias
  – C5-6 distribution most common
  – Lower trunk involvement is rare

• Weakness
  – Biceps, deltoid, SS, Infraspinatus

• Transient symptoms
  – 1-2 minutes for resolution
  – Prolonged symptoms are relatively common
Presentation

• Bilateral symptoms is a red flag
  – This is not a stinger
  – SCI until proven otherwise
Compression

Direct Trauma

Compression
Traction Injury

• Most common mechanism described
• Upper trunk BP injury
• Blocking and tackling, landing on the shoulder
  – Football>wrestling
• Younger athlete

Safran, 2004
Compression

• Mature athletes
  – Collegiate/professional
• Neck extension with lateral flexion
  – Ipsilateral symptoms
• Foraminal narrowing
  – C4-5, C5-6 levels
• Underlying spondylitic changes
Direct trauma

- Blow to Erb’s point or supraclavicular region
- Superficial, vulnerable location of the plexus
- Compression of plexus between helmet/shoulder pad and superior medial scapula
Pathophysiology

Excessive compression or traction on peripheral nerves

- Obstruct neural blood flow
- Deform myelin sheaths
- Slow axonal transport
- Disrupt nerve conduction
Seddon’s criteria

- **Neurapraxia (Grade I)**
  - mildest form
  - disruption of nerve function involving demyelinization
  - axonal integrity is preserved
  - full recovery minutes to days
  - usually within 2 weeks with remyelination

- **Axonotmesis (Grade II)**
  - more severe injury
  - axonal damage, Wallerian degeneration
  - intact epineurium
  - weeks to months (at least 2 weeks)
  - EMG findings 2-3 weeks after injury

- **Neurotmesis (Grade III)**
  - most severe
  - persist for > 1 year with little to no clinical improvement
  - permanent deficit, rarely during sports
  - MVA, high velocity impact
Injury Susceptibility

Nerve root

- Lack a protective epineurium, perineurium, fascicular structure
- Dural ligaments anchor roots
- Roots confined within unforgiving structures of spinal canal

Brachial plexus

- More exposed to direct trauma
- Surrounded by more forgiving soft tissues/muscles
- Plexiform structure of BP tolerates tensile forces

Modified from Safran, 2004
Return to Play

• Uncomplicated Scenario
  - May return the same day (if first time) symptoms completely resolve
  - Full, painless cervical ROM and UE strength

Cantu, 1998
Vaccaro, 2001, 2002
Safran, 2004
Weinstein, 2009
Return to Play

• Athlete with “significant and sustained” stinger (even if the first), should not return to game
  – Needs work up

• No RTP if symptoms do not resolve on the field (<15 min)

Cantu, 1998
Vaccaro, 2001, 2002
Safran, 2004
Weinstein, 2009
Return to Play

• Full recovery >15 minutes to 72 hours:
  – RTP in 1 week
  – Assuming first stinger
  – Rehabilitation

Weinstein, 2009
Return to Play

• Multiple stingers in same season
  – 2 stingers: 2 weeks
  – 3 stingers: 3 weeks
    • Consider ending the season
  – Rehabilitation

• Prolonged recovery and/or multiple stingers
  – More severe symptoms
  – Up to 5x increased risk for recurrence
  – Further work-up
  – Rehabilitation

Weinstein, 2009
Andrish 1977
Albright 1985
• **No contraindications:**
  – 1\textsuperscript{st} episode, transient and no residual symptoms
  – Athlete suffering repeated burners may return that day if <3 prior episodes lasting less than 24 hours w/ full ROM and no neuro deficits

• **Relative contraindications:**
  – Prolonged symptoms >24 hrs
  – ≥3 stingers/burners with full ROM, no pain, no neuro deficits
  – Discussion w/ player, family, coaches of risks

• **Absolute contraindications:**
  – Neck pain, decreased ROM, neuro deficits following injury

Vaccaro, 2001
Diagnostic Testing

• Radiographs cervical spine
  – AP, Lat, Obliques, Flex-ext views

• MRI cervical spine (+/- CT scan)

• Electrodiagnostic testing (NCS/EMG)
  – Symptoms >2-3 weeks
CERVICAL STENOSIS

- Torg Ratio: dated and out of favor
- More recently “Functional cervical spinal stenosis”
- Defined as “cervical spinal canal so small as to obliterate the protective cushion of CSF”

Cantu 2005
Cervical Stenosis

(a) Grade 0
(b) Grade 1
(c) Grade 2
(d) Grade 3

Muhle 1998
Transient Quadriplegia

- Transient neurologic sequelae of para-, hemi-, or tetraplegia
- No radiologic findings
- Symptoms last < 24 hours
- Not a stinger!!
Hyperextension Pincer Mechanism

- The cord is compressed between the inferior margin of the superior vertebral body and the anterior superior aspect of the spinolaminar line.
Hyperflexion

• With hyperflexion, the anterosuperior aspect of the spinolaminar line of the superior vertebra and the posterosuperior margin of the inferior vertebra would be the "pincers."
Transient Quadriplegia

• Any high risk athlete with neurological symptoms in more than one limb, no matter how transient should be evaluated with a cervical MRI

Concannon 2012
Absolute Contraindications

- Persistent neurological findings, cervical pain, or loss of ROM
- MRI evidence of spinal cord defect or edema
- Functional spinal stenosis on MRI
- Acute cervical fracture or ligamentous disruption
- Acute or chronic cervical disc herniation
- Cervical spine segmental instability
- Arnold-Chiari malformation
- Basilar invagination

- Os odontoideum
- Atlanto-occipital fusion or instability
- Klippel-Feil fusion greater than two levels
- Multi level surgical fusion
- Segmental instability was defined as anterior dens interval of 4 mm
- C1-C2 hyper-mobility
- Kyphotic deformity on flexion or extension radiographs
Conclusion

• Disagreement in the way cervical stenosis is measured.
• Some feel increased risk.
• In the presence of stenosis, withhold participation in contact sport.
• Second episode, another complete work-up is necessitated.
Hovis, 1994

- 5 collegiate FB players
- Neck roll, cowboy collar, orthosis
- Reduction in hyperextension
  - Shoulder pads = 3.52%
  - Neck roll = 33.18%
  - Cowboy Collar = 32.36%
  - Customized orthosis = 48.36%
- No statistical difference in lateral flexion
Gorden, 2003

- 15 Div 1 FB players
- Test 3 collars
  - Cowboy collar, A-force neck collar, foam neck roll
- All reduced hyperextension
- Greater reduction in extension w cowboy collar
- Lateral flexion not limited
- Findings c/w Hovis et al
Rowson, 2008

• Biomechanical analysis of collars
  – “dummies”

• Decreased loads with use of collars
  – Kerr > cowboy/Bullock

• Related to decreased ROM
Equipment/Prevention

- Shoulder pad assessment
- Neck rolls/collars
  - No studies show a reduction in stingers
- Assessment of tackling techniques
  - Avoidance of shoulder depression and lateral flexion and neck extension
  - Upright, vertical technique
    - “See what you hit”
- Neck and Shoulder strengthening/conditioning
Rehabilitation

• Mainstays of treatment
  – Protection
  – Pain and inflammation control
  – Address postural deficits
    • Correction of inflexibility and strength imbalances
  – Myofascial techniques/joint mobilizations
  – Traction
    • Manual vs mechanical

Weinstein, 1998, 2009