What is cervical myelopathy and how does it differ from cervical radiculopathy?
Can we distinguish ALS and shoulder pathology from spinal cord or root compression in the office setting?

Ronald Moskovich, MD, FRCS
- **C1-2:**
  50% of cervical rotation

- **Subaxial:** Lordosis
Disk
Facet
Uncovertebral Joint
Pathophysiology

- Skeletal Maturity to 3rd Decade
  - Few morphologic changes occur before age 30
- 4th & 5th Decades
  - Intervertebral Disc
  - Zygopophyseal Joints
Pathophysiology

- 6th Decade & Beyond
- Cervical Spondylosis
Natural History of Spondylosis

• Most common in 4th decade of life
• Male:Female: 1.4 : 1
• Most common levels: C5-6, C6-7
• Risk factors include:
  • smoking
  • frequent lifting of heavy objects
  • frequent diving from board
Anterior Arthrodesis

Distribution per level

- Patients: 157
- Levels: 214
Cervical Spondylosis

Clinical Presentation

- Neck Pain
- Cervical Radiculopathy
- Cervical Myelopathy
LMN

- Upper motor neuron
- Motor neuron cell bodies (anterior horn, ventral gray column)
- Lower motor neuron
Radiculopathy

Nerve root dysfunction
Usually compressive

Herniated disk
Osteophyte
Clinical Presentation

Cervical radiculopathy (LMN)

- Weakness, altered sensation and hyporeflexia
- Specific nerve root distribution

Cervical Myelopathy (UMN)

- Altered gait, weakness, hyperreflexia
- Bowel/bladder dysfunction
- Lhermittes sign, Babinski sign, clonus

- Radiculopathy and myelopathy can coexist
- Neck pain, interscapular pain, and decreased range of motion
Dermatomes
## Reflexes

<table>
<thead>
<tr>
<th>Nerve Root</th>
<th>Reflex</th>
<th>Sensation</th>
<th>Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4</td>
<td>None</td>
<td>Back of neck, Scapula, Lateral arm</td>
<td>None</td>
</tr>
<tr>
<td>C5</td>
<td>Biceps</td>
<td>Lateral arm</td>
<td>Deltoid, Biceps</td>
</tr>
<tr>
<td>C6</td>
<td>Brachioradialis</td>
<td>Lateral forearm, Thumb, Index finger. Middle finger</td>
<td>Wrist extensors</td>
</tr>
<tr>
<td>C7</td>
<td>Triceps</td>
<td>Middle finger</td>
<td>Triceps, Wrist flexors</td>
</tr>
<tr>
<td>C8</td>
<td>None</td>
<td>Ring, Little finger</td>
<td>Finger flexors, Intrinsics</td>
</tr>
</tbody>
</table>
Muscle Strength

5 - Normal
   Complete ROM against gravity with full resistance

4 - Good
   Complete ROM against gravity with some resistance

3 - Fair
   Complete ROM against gravity

2 - Poor
   Complete ROM with gravity eliminated

1 - Trace
   Evidence of slight contractility

0 - Zero
   No evidence of contractility

Axillary nerve: C5, C6
C5 Radiculopathy

Motor
• Deltoid
• Biceps

Reflex
• Biceps

Sensation
• Lateral upper arm
C6 Radiculopathy

Motor
- Biceps
- Wrist extensors

Reflex
- Brachioradialis

Sensation
- Lateral forearm
- Radial digits
C7 Radiculopathy

Motor
- Triceps
- Wrist flexors
- Finger extensors

Reflex
- Triceps

Sensation
- Middle digit
C8 Radiculopathy

Motor
- Hand intrinsics
- Finger flexors

Reflex
- None

Sensation
- Medial forearm
- Ulnar digits
Diagnostic Evaluation

• Plain radiograph series
• Flexion-extension
  • history of trauma, spondylosis, or evidence of instability (e.g., spondylolisthesis)
• MRI
  • If considering surgery or injections
• Cervical myelography and postmyelography CT
  • Severity of compression
  • Dynamic study
• Electrodiagnostic studies
Differential Diagnosis

- Intrinsic pathology of the shoulder, elbow, or wrist
  - can occur concurrently
- Peripheral nerve entrapment syndromes
  - double crush syndrome
- Thoracic outlet syndrome
- Other neurologic disorders
  - Neuritis, MS, ALS, tumors
- Infection
  - Discitis
  - vertebral osteomyelitis
UMN

Motor neuron cell bodies (anterior horn, ventral gray column)

Upper motor neuron

Lower motor neuron
Cervical Spondyloptic Myelopathy

“Cervical spondyloptic myelopathy and lumbar stenosis belong in a special category because neither present with arm or leg pain. Both syndromes can be easily overlooked if not specifically considered during the history and physical examination.”
Cervical Spondylotic Myelopathy

• CSM is a clinical syndrome with a characteristic pattern of signs and symptoms resulting from spinal cord compression caused by degenerative disease of the cervical spine.

• Most common cause of acquired spastic paraparesis age >50
  • Gait abnormalities
  • Hand dysfunction
  • Motor weakness
  • Bowel and bladder dysfunction
Pathophysiology

• Multifactorial
  • Congenital cervical stenosis
  • Spondylosis
  • Direct spinal cord compression
  • Impairment of blood supply to cord
    • Brain
Congenital Cervical Stenosis

• Average subaxial canal diameter = 14 mm
  • Moskovich, 1996

• Canal <12 mm ➔ high correlation with myelopathy
  • Arnold, Ann Surg 1955

• Average sagittal canal diameter 11.8 mm in myelopathic patients (range 9 to 15mm)
  • Adams and Logue, Brain 1971
Mechanical Factors

- Functional diameter may be further reduced with:
  - flexion
  - extension
- Posterior:
  - buckling of the ligamentum flavum
- Compensatory subluxation above stiff spondylotic segments
- Kyphotic deformities flex and flatten cord
Ischemia ultimately produces demyelinization

- Ligation studies in dogs demonstrate the additive effect of ischemia with increasing neurologic deficit
  - Schwann Cell is very sensitive to either pressure or vascular impairment
  - Neuronal cells themselves remain viable
  - No gray matter infarction or gliosis noted
  - Postulated that some of these neurologic lesions may be reversible.
Physical findings associated with cervical spondylotic myelopathy

• There is no pathognemonic symptom or physical sign for myelopathy
• Diagnosis established by affirmation of clinical signs and symptoms

<table>
<thead>
<tr>
<th>Early Findings</th>
<th>Late Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disdiadochokinesia</td>
<td>Spasticity</td>
</tr>
<tr>
<td>Difficulty with tandem gait</td>
<td>Difficulty with routine gait</td>
</tr>
<tr>
<td>Fine motor deficits</td>
<td>Gross motor deficits</td>
</tr>
<tr>
<td>Mildly increased reflexes</td>
<td>Markedly increased reflexes</td>
</tr>
<tr>
<td>Clonus (mild and unsustained)</td>
<td>Clonus (sustained)</td>
</tr>
<tr>
<td>Decreased proprioception</td>
<td>Gross difficulty with balancing</td>
</tr>
</tbody>
</table>
Physical Findings in Myelopathy

• Classically lower motor neuron involvement at level of lesion and upper motor neuron involvement below this level
  • “Uppers in the lowers and lowers in the uppers”

• Other classic UMN findings include spasticity, clonus, wide-based gait, positive Hoffman’s and Babinski’s sign as well as other various pathologic reflexes.
Upper Motor Neuron Signs

- Hyperreflexia
  - Hoffman's sign
  - Pectoral jerks
  - Clonus
- Babinski
- Lhermitte's sign
- Proprioception
  - Long tract
Babinski Reflex
Hoffman sign
Natural History

• Rapid deterioration in pts with minimal symptoms is unlikely (±)

• Untreated individuals can expect periods of worsening and static disability

• Linear and relentless progression of myelopathy
Ankylosing Spondylitis
OPLL
OPLL
Differential Diagnosis

- Motor Neuron Disease / ALS
- Multiple Sclerosis
- Other Degenerative Processes
- Neoplastic Lesions
ALS

• Motor Neurone Disease (MND)
• A group of diseases in which the neurones that control muscles undergo degeneration and die.

• Subtypes of motor neurone disease

• Amyotrophic Lateral Sclerosis (ALS)
• Progressive Muscular Atrophy (PMA)
• Progressive Bulbar Palsy (PBP)
• Primary Lateral Sclerosis (PLS)
Differential Diagnosis: CSM vs. ALS

<table>
<thead>
<tr>
<th>Feature</th>
<th>CSM</th>
<th>ALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Older than 55</td>
<td>Older than 55</td>
</tr>
<tr>
<td>MRI findings</td>
<td>Spondylosis</td>
<td>Spondylosis</td>
</tr>
<tr>
<td>Fasciculations</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Atrophy of arms</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Atrophy of legs</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Denervation</td>
<td>Absent</td>
<td>Present</td>
</tr>
</tbody>
</table>

~15% of patients who underwent surgery for CSM were later found to have other diagnoses
Shoulder PAIN
- Common complaint
- Cervical spine vs. shoulder pathology
- Multiple pathologies?
- Source of pain?
Spine vs. Shoulder

• Overlapping symptoms
  • 25% C-spine patients w/ shoulder pathology
  • 25% Shoulder patients w/ c-spine pathology

• Referred pain?
  • injection to c-spine can relieve pain in shoulder
  • injection to shoulder may relieve pain in neck
Spine vs. Shoulder

- Guidelines for differentiation
  - Clinical history
  - Physical examination
    - Routine maneuvers
    - Provocative maneuvers
  - Radiographic examination
  - Diagnostic injections
History

- Traumatic etiology?
  - Position of arm
  - First location of pain (neck / shoulder / arm)
  - Changes from injury
History

• Pain
  • Location (anterior versus posterior)
  • Radiating?
  • Constant vs. activity related?
  • Exacerbation (related to motion?)
Examination

• Inspection
  • Alignment
  • Focal atrophy
  • Winging

• Motion

• Cervical motion
  • Reproduction of symptoms?

• Shoulder motion
  • Active versus passive motion
  • Must r/o adhesive capsulitis
Examination

• Palpation
  • Focal tenderness?

• Neurological testing
  • Strength and sensation
  • Entire upper extremity
  • EMG / NCV
    • Diagnostic vs. confirmatory

• Provocative maneuvers
  • nerve root compression (Spurling maneuver)
Examination

- Provocative maneuvers
  - Impingement
  - Biceps
  - Stability
Radiographic Exam

- X-rays (routine)
  - orthogonal views required
Radiographic Exam

- MRI
  - Highly sensitive for soft tissue defects
  - Clinical correlation?
Radiographic Exam

- **> 60 years old (n=46)**
  - No tears: 46%
  - Partial tears: 26%
  - Complete tears: 28%

- **40-60 years old (n=25)**
  - No tears: 72%
  - Partial tears: 24%
  - Complete tears: 4%

- **<40 years old (n=25)**
  - No tears: 96%
  - Partial tears: 4%
Injections

• Diagnostic versus therapeutic
  • Image guidance for spine

• Three shoulder locations
  • Glenohumeral joint
  • AC joint
  • Subacromial space
Summary

• Overlapping symptomatology
• Difficult to identify source(s) of pain
• History & Exam sufficient for most patients
• Ancillary evaluations for confirmation
Thank You

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