Clinical Evaluation and Initial Treatment for Degeneration of the Cervical Spine

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Introduction

• Spondylosis is **age** related degenerative changes within the spine
• Broad spectrum of clinical presentation and severity
• Age related degenerative changes are ubiquitous
  – ~ 25% of people < 40 years
  – ~ 50% of people 40 to 60 years
  – ~ 85% of people > 60 years

Matsumoto et al, 1998
Predisposing Factors
Epidemiology

• **Axial Neck pain** – prevalence of 66% in American adults\(^1\)
  – More common in Females
  – *Non dermatomal* pain distribution

• **Cervical Radiculopathy** – incidence 83 per 100,000
  – Prevalence 3.5 per 1,000 with peak incidence in sixth decade of life\(^2\)
  – Pain/sensory change or neuro deficit *in a dermatomal distribution*

• **Cervical Myelopathy** – true incidence unknown
  – Most commonly acquired spastic paraparesis in adults
  – *Long tract findings* in upper/lower extremities due to compression of the spinal cord by spondylotic change
Disc Degeneration

- Altered Matrix Structure/Metabolism
  - Loss of proteoglycans
  - Decrease hydrostatic pressure
  - Decreased Disc Height
  - Fibrosis of NP
  - Up regulation of catabolic enzymes

- Inappropriate Mechanical Response to Loading
  - AF damage
  - Osteophyte Formation
  - Facet arthrosis
  - Altered biomechanics results in progressive mechanical failure
66% of adults experience axial neck pain
5% develop chronic pain
Depalma, et al – Axial neck pain following 3 months of non operative management
  - 21% complete resolution
  - 49% partial relief
  - 22% no relief
Rothman, et al – 23% with axial neck pain had persistent disability at 5 years
Natural History - Radiculopathy

• More than 50% of adults will experience radicular symptoms

• Rarely progresses to myelopathic symptoms

• Majority of symptoms are transient

• Approximately 32-55% of patients will have residual or persistent symptoms

• It is this 1/3 of patients with persistent symptoms who are surgical candidates
Natural History - Myelopathy

• Natural history confounded by co-morbidities
• Clarke and Robinson – 1956 on 120 patients
  – 75% episodic progression
  – 20% showed slow steady progression
  – 5% rapid onset followed by periods of stability
• Multiple other series – progressive disability followed by static periods\textsuperscript{1,2,3}
• Poor outcomes associated with non operative management\textsuperscript{4}

\textsuperscript{1}Lees et al 1963, \textsuperscript{2}Symon et al 1967, \textsuperscript{3}Phillips et al 1973, \textsuperscript{4}Sampath et al 2000
Randomized control trial:

- Patients with mild to moderate non progressive or slowly progressive myelopathy were found to have similar outcomes after either non surgical or surgical treatment.

A trial of non-surgical treatment IN MILD CASES does not decrease the potential for ultimate recovery.
Pathogenesis – Axial Neck Pain

- Muscle/Ligamentous factors
- Prior Neck Injury
- Vascular insufficiency

Croft, PR et al 2001
Pathogenesis – Axial Neck Pain
Pathogenesis - Radiculopathy

• Etiology
  – DDD
  – Osteophytes
  – Facet hypertrophy
  – Instability
  – Foraminal stenosis (uncinate pathology)

• Common Pathology
  – Nerve Root compression
Pathogenesis-Radiculopathy

- Multiple potential sites of compression
  - Hard
  - Soft
Compression causes intraneural edema, inflammation, and eventually fibrosis.

Herniated disc tissue elutes inflammatory mediators through release of non neurogenic mediators.

<table>
<thead>
<tr>
<th>Non Neurogenic</th>
<th>Neurogenic</th>
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<tbody>
<tr>
<td>Histamine</td>
<td>Substance P</td>
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<tr>
<td>Bradykinin</td>
<td>Cholecystokinin like substance</td>
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<tr>
<td>Serotonin</td>
<td>Vasoactive intestinal peptide</td>
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<tr>
<td>Acetylcholine</td>
<td>Gastrin releasing peptide</td>
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<tr>
<td>TNF - α</td>
<td>Calcitonin gene related peptide</td>
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<tr>
<td>Prostaglandin E₂</td>
<td>Angiotensin II</td>
</tr>
<tr>
<td>DiHETE</td>
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<td>Leukotrienes</td>
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<tr>
<td>ATP</td>
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<tr>
<td>Interleukin 6,8</td>
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</table>
Pathogenesis-Radiculopathy

- DRG has fenestrated endoneurial capillaries
- DRG sensitized resulting in prolonged neural discharges
- Synthesis and release of nociceptive transmitters

Rat DRG cells treated with immunoflorescent staining for Beta – tubulin (Green) and CRGP (Red). Lonza LLT, 2010.
Pathogenesis - Myelopathy

- Mechanical compression of the spinal cord
  - Developmental Stenosis (13mm)
  - Transverse area of the cord <60mm²
  - AP cord ratio < 40%
  - Banana shaped cord
Pathogenesis - Myelopathy

- Ischemia
  - Tenting
  - Vasospasm
- Hyperextension
- Instability
Pathogenesis - Myelopathy

- Severe compression causes
  - Cystic cavitation
  - Gliosis
  - Demyelination

- Interruption of neural transmission

- Long tract signs
  - Babinski
  - Hoffman
  - Inverted Radial Reflex
Clinical Evaluation - Axial Neck Pain

• Localized pain and tenderness
  – Trigger points

• Pain exacerbated by
  – Flexion – Myofascial
  – Extension/Rotation – Discogenic Pain
  – Rotation – atlantoaxial articulation
  – Suboccipital pain – Upper Cervical

• Exam heart, lungs, abdomen

• Cutaneous manifestations

• Fever, weight loss, night pain/non mechanical pain
Clinical Evaluation - Radiculopathy

- Henderson et al. reviewed 736 patients with Radiculopathy
  - 99% arm pain
  - 85% sensory deficits
  - 80% neck pain
  - 71% reflex deficits
  - 68% motor deficits
  - 52% scapular pain
  - 10% headaches
  - 1% cervical angina

- 55% of patients had pain in a strictly radicular distribution

- 80% of neurologic deficits corresponded with level of pathology
Clinical Evaluation - Radiculopathy
Clinical Evaluation - Radiculopathy

<table>
<thead>
<tr>
<th>Root</th>
<th>Symptoms</th>
<th>Affected Motor Function</th>
<th>Reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3</td>
<td>Occipital headache, retro-orbital or retroauricular pain</td>
<td>—</td>
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</tr>
</tbody>
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Clinical Evaluation - Radiculopathy

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<tr>
<td>C4</td>
<td>Base of neck, trapezial pain</td>
<td>—</td>
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<tbody>
<tr>
<td>C5</td>
<td>Lateral arm pain</td>
<td>Deltoid</td>
<td>Biceps</td>
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<tr>
<td>C6</td>
<td>Radial forearm pain, pain in the thumb and index fingers</td>
<td>Biceps, wrist extension</td>
<td>Brachioradialis</td>
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</tbody>
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Clinical Evaluation - Radiculopathy

Common Cervical Radiculopathy Patterns

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<tr>
<th>Root</th>
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<tbody>
<tr>
<td>C7</td>
<td>Middle finger pain</td>
<td>Triceps, wrist flexion</td>
<td>Triceps</td>
</tr>
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[Diagrams showing the C7 root and its affected areas]
Clinical Evaluation - Radiculopathy

### Common Cervical Radiculopathy Patterns

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<tr>
<td>C8</td>
<td>Pain in the ring and little fingers</td>
<td>Finger flexors</td>
<td>—</td>
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Clinical Evaluation - Radiculopathy

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<tr>
<td>T1</td>
<td>Ulnar forearm pain</td>
<td>Hand intrinsics</td>
<td>—</td>
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Dermatomes

- L1 – Groin
- L2 – Upper anterior thigh
- L3 – Lower anterior thigh
- L4 – Medial calf
- L5 – Lateral calf and dorsum of foot
- S1 – Posterior calf and lateral foot
- S2 – Posterior upper thigh
- S3-S5 – Peri-anal
Can be difficult to detect mild myelopathy on exam

Clumsiness or loss of fine motor skills in the hands

Awkward gait or difficulty maintaining balance

Proximal motor groups in legs more commonly involved

Approximately 15% without neck pain\(^1\)

Emery et al, JBJS 1998
Clinical Evaluation - Myelopathy

- Long track signs
  - Babinski
  - Hoffman
  - Inverted radial reflex
  - Scapulohumeral reflex
- Rarely incontinent
- Abnormal sensation (dorsal columns)
- Myelopathy hand
  - Intrisic muscle wasting
  - Finger escape sign
- Evaluate Gait
Lateral X-ray

Lateral film diagnostic in 85%

2 at 6 and 6 at 2

The 5 lines

3.5mm or 11 degrees

AAI < 2-3 mm
• 7 vertebral bodies
  – occipital-atlanto-axial articulation
  – Sub Axial C spine
• Corresponding nerve root exits above vertebral body
  – C8 exits above T1
• Vertebral artery enters foramina at C6
Radiographic Evaluation
Plain Radiographs

- Degenerative change
  - Disk space narrowing
  - Osteophytes
  - Facet/uncovertebral pathology
  - Endplate sclerosis

- Pavlov ratio

- Flexion/Extension views
Radiographic Evaluation
CT with Myelography

• Plain CT
  – OPLL
  – Osteophytes
  – Foramina Stenosis

• Myelography
  – Distinguishes osseous from soft tissue impingement\textsuperscript{1,2}
  – Better imaging in patients with metal artifact

\textsuperscript{1}Jahnke et al, 1991
\textsuperscript{2}Shafaie et al, 1999
Radiographic Evaluation
Magnetic Resonance Imaging

• Standard for evaluating soft tissues
  – Neural element
  – Disk
  – Joint capsule
  – Ligaments

• Findings Ubiquitous
  – Teresi et al, 1987
  – Boden et al, 1990
Ohshio et al, correlated histology with signal change
- High intensity signal on T2 weight image – edema
- Low intensity signal of T1 – necrosis, myelomalacia, spongiform change

Intramedullary signal changes in the cord detected in more than 60% of patients with symptomatic cervical myelopathy

Morio et al, Spine 2001
Electrodiagnostic Evaluation

• May help differentiate
  – Myelopathy
  – Radiculopathy
  – Peripheral nerve entrapment
  – Brachial plexopathy

• Useful in detecting subclinical myelopathy\(^1,2\)

• Normal preoperative SSEP have been correlated with better recovery rates after surgery for myelopathy\(^3\)

\(^1\)Bednarik et al, Eur Spine 1998
\(^2\)Chistyakov et al, Spine 2004
\(^3\)Lyu et al, J Neurosurg 2004
Electrodiagnostic Evaluation

• Low diagnostic sensitivity for primary radiculopathy\textsuperscript{1,2}
  
  – Poor concordance with MRI findings
  
  – Less likely to show abnormality in purely sensory radiculopathy

\textsuperscript{1}Nardin et al, Muscle nerve 1999
\textsuperscript{2}Wilbourn et al, Muscle nerve 1988
Non Surgical Management

- Pharmacology
- Immobilization
- Traction
- Manipulation
- Physical therapy
- Injections
Non Surgical Management
Pharmacology

• Pharmacology
  – Non steroidal
  – Narcotics
  – Muscle relaxants
  – Steroids
  – Anti Depressants

Non Surgical Management
Immobilization

- Soft collar
  - Minimize muscle spasm
  - Diminish inflammation
- No effect on duration of pain
- Prolonged use can lead to paraspinal muscle atrophy
- No role in treatment of myelopathy

Naylor et al, J Rheum 1991
Non Surgical Management Traction

The effect of cervical traction combined with conventional therapy on grip strength on patients with cervical radiculopathy

Mohammad Taghi Joghataei Iran University of Medical Sciences and University of Social Welfare and Rehabilitation Sciences, Tehran, Amir Massoud Arab University of Social Welfare and Rehabilitation Sciences, Tehran, Iran and Hossein Khaksar Osteopathic and Rehabilitation Center, Toronto, Ontario, Canada

Received 9th November 2003; returned for revisions 9th January 2004; revised manuscript accepted 25th July 2004.

• May help relieve radicular symptoms by temporarily enlarging neuroforaminal space
• Contraindicated in myelopathy
Non Surgical Management Manipulation

- May provide transient benefit for cervicogenic headache, radicular symptoms
- Contraindicated in myelopathic patients
- **Risks**
  - Exacerbation of symptoms
  - Vertebral artery injury

Hurwitz et al, Spine 1996
Non Surgical Management
Physical Therapy

- Physical modalities **DO NOT** alter natural history of radiculopathy or axial neck pain
  - Heat/cold compress
  - Ultrasound
  - TENS
- Postural education, ergonomics and lifestyle modifications may be beneficial
- Isometric strengthening, ROM, and aerobic conditioning may improve neck pain

1Levine et al, JAAOS 1996
3Chiu et al, Spine 2005
Non Surgical Management Injections

- Indicated for cervicogenic headache, axial neck pain, radiculopathy
- Selective nerve root Blocks
  - Specific targeting or nerve root and DRG
  - Diagnostic information

Linqui et al, 2010
Surgical Management
Degenerative Cervical Spondylosis

• Approximately 80% of patients with neck pain respond favorably to non surgical management\(^1\)

• Indications for Surgery
  1. Severe pain caused by degenerative disease which has failed conservative measures for >12 months
  2. Progressive or debilitating neurological deficit
  3. Radicular symptoms for > 3 months and pathology on neuroimaging studies that corresponds to clinical picture
  4. Pseudoarthrosis
  5. Instability
  6. Hardware failure

Albert et al, JAAOS 1999
Surgical Management
Cervical Spondylotic Myelopathy

• Factors which affect surgical management
  – Patient age
  – Comorbidities
  – Duration of symptoms
  – Rate of deterioration
  – Sagittal alignment
  – Instability
  – Neurological dysfunction

• Surgery can be expected to halt progression of neurological dysfunction

• Degree of recovery depends largely on severity at time of intervention\(^1\)

Fujiwara et al, JBJS 1989
• Positive Prognostic factors
  – Larger transverse cord area
  – Younger patient age
  – Shorter duration of symptoms
  – Single level involvement
Surgical Management
Cervical Spondyloptic Myelopathy

- Anterior Approaches
  - ACDF
  - Corpectomy
    - With strut graph
    - Instrumentation

- Posterior Approaches
  - Laminectomy
  - Laminectomy with fusion
  - Laminoplasty
Surgical Management
Cervical Spondylotic Myelopathy

ANTERIOR APPROACH

• **Advantages**
  – Direct decompression
  – Stabilization of arthrodesis
  – Correction of sagittal deformity
  – Muscle sparing approach
  – Good axial pain relief
  – Very low infection rate

• **Disadvantages**
  – Dysphasia/hoarseness
  – Devastating potential complications
  – Graft/fusion related complications
  – Need for post operative bracing
  – Loss of motion
  – Adjacent segment degeneration

POSTERIOR APPROACH

□ **Advantages**
  ▪ Less loss of motion
  ▪ Not as technically difficult
  ▪ Less post operative bracing required
  ▪ Avoids graft complications

□ **Disadvantages**
  ▪ Indirect decompression
  ▪ Limited indications (kyphosis/instability)
  ▪ Inconsistent axial neck pain results
  ▪ Late instability

Emery SE, JAAOS 2001
CASE PRESENTATION

SB

- CC: Progressive hand clumsiness, neck and arm pain
- HPI: 70 yo male presents with 6 months poor coordination and balance. No bowel or bladder incontinence.

- PMH: HTN, CAD, OA
- PSH: Cardiac Cath, Right TKA
- Meds: HCTZ, Metoprolol, Celebrex, Oxycodone, ASA
- All: NKDA
- SH: negative
- FH: noncontributory
### CASE PRESENTATION

**SB**

- Good tone bilat Upper/Lower ext

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- Hypoesthesia in C6 & C7 distributions Right
- +Hoffman & Babinski
- Brisk brachioradialis reflex right side
CASE PRESENTATION
SB
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QUESTIONS???

Thank You