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Differential Diagnosis of Cervical Radiculopathy

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Objectives

As a result of this course, participants will be able to:

- identify the red flags in a patient to determine if it is appropriate to treat, treat and refer, or refer a patient to a physician.

- differentiate the components of an examination to evaluate a patient with cervical radiculopathy.

- describe characteristics and clinical patterns in a patient with neck pain to differentiate cervical radiculopathy from other neuromusculoskeletal conditions.
Question 1

- How often do you evaluate patients for cervical radiculopathy:
  A. more than 5 in a month
  B. more than 15 in a month
  C. less than 5 in a month
  D. all the time

Cervical radiculopathy (?)

- Neck pain associated with radiating arm pain

- 83.2 / 100,000 incidence
  - 107.3 for men
  - 63.5 for women
- Prevalence increases in 5th decade, peak incidence in 5th & 6th decade for both sexes
Question 2

- What spinal level do you suspect is most often considered the problem level in cervical radiculopathy?
Manifestations

- Pain
- Numbness
- Weakness
- Paresthesia

Clinical Exam along with history

- Dermatomal testing
- Myotomal testing
- Reflexes
- Special tests
Dermatomal testing

Legend

- Mechanism of injury
- Lesion
- Sensory stimulus
- Light touch stimulus
- Function intact
- Function lost

First-order neuron
Second-order neuron
Third-order neuron
Sensory impairment
The Dorsal Column-Medial Lemniscal System

Discriminative touch, vibration, and position information from the body is conveyed by the dorsal column-medial lemniscal system (DCML). The DCML is a crossed system. It originates from mechano-receptors (sensory receptors sensitive to mechanical deformation) located in the body wall and projects to the contralateral cerebral hemisphere via a three neuron projection system. The DCML is comprised of the fasciculus gracilis and fasciculus cuneatus.

Fasciculus gracilis: Behavioral Description

Fasciculus gracilis: light touch, vibration, and position sense from the contralateral leg and lower trunk

Consists of a 3-neuron projection system extending from receptors in the periphery to the primary somatosensory cortex (Click neuroanatomical explanation)

Click to animate

Neuroanatomical Explanation
Fasciculus Gracilis: Neuroanatomical Description

First-order neurons
Cell body: dorsal root ganglion (DRG)
Distal axon: innervates mechanoreceptors in leg and lower trunk via peripheral nerves
Proximal axon: enter dorsal column (fasciculus gracilis), ascend ipsilaterally and terminate in the nucleus gracilis

Second-order neurons
Cell body: nucleus gracilis
Axon: decussates in the medulla and projects to the contralateral thalamus (ventral posterior lateral nucleus, VPL) via the medial lemniscus

Third-order neurons
Cell body: VPL of thalamus
Axon: ascends via the posterior limb of the internal capsule and terminates in the primary somatosensory cortex

Fasciculus Cuneatus: Behavioral Description

Fasciculus cuneatus: light touch, vibration, and position sense from the contralateral arm and upper trunk

Consists of a 3-neuron projection system extending from receptors in the periphery to the primary somatosensory cortex (Click neuroanatomical explanation)
**Fasciculus Cuneatus: Neuroanatomical Description**

**First-order neurons**
Cell body: dorsal root ganglion (DRG)
Distal axon: innervates mechanoreceptors in arm and upper trunk via peripheral nerves
Proximal axon: enter dorsal column (fasciculus cuneatus), ascend ipsilaterally and terminate in the nucleus cuneatus

**Second-order neurons**
Cell body: nucleus cuneatus
Axon: decussates in the medulla and projects to the contralateral thalamus (ventral posterior lateral nucleus, VPL) via the medial lemniscus

**Third-order neurons**
Cell body: VPL of thalamus
Axon: ascends via the posterior limb of the internal capsule and terminates in the primary somatosensory cortex

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**Myotomal testing**
Voluntary Knee Extension: Behavioral Description

Voluntary movement is controlled by a system of brain and spinal motor centers linked by neuronal pathways. The primary motor pathway (Corticospinal tract) is crossed such that the left hemisphere controls movement of the right half of the body and vice versa. Motor pathways consist of upper and lower motor neurons. Upper motor neurons originate in the precentral gyrus, decussate in the medulla, descend in the lateral column of the spinal cord, and terminate on lower motor neurons in the ventral horn. Lower motor neurons exit the CNS and innervate skeletal muscles via the peripheral nervous system.

Neuroanatomical Explanation
Voluntary Knee Extension: Neuroanatomical Description

The cell body of the **upper motor neuron** is located in the precentral gyrus (somatotopically organized). The axon descends through the internal capsule, decussates in the medulla, descends through the lateral column of the spinal cord and terminates in the ventral horn.

The cell body of the **lower motor neuron** is located in the ventral horn. The axon exits the CNS via ventral rootlets of spinal nerves and innervates skeletal muscle via a peripheral nerve.

**Skeletal muscles** contract to produce the force to extend the knee.

**Behavioral Explanation**

**Stimulus**
- UMN
- LMN

**Question 3**

In cervical radiculopathy, which test is **best** to determine if a patient has this condition:

A. weakness
B. sensory loss
C. diminished reflexes
D. all of the above
Segmental Reflexes

A reflex is defined as an involuntary, stereotyped response to a sensory input.

Segmental Reflex Pathway

- All you need is...
  - a receptor
  - an afferent neuron (with cell body in a dorsal root ganglion or other sensory ganglion) and
  - an efferent neuron.

- Most reflexes involve one or more interneurons (exception: the stretch reflex, which is monosynaptic).
Questions 4 & 5

- Are there clinical exam findings that you know of that helps determine if a patient has cervical radiculopathy?

- What do you use to help you diagnose this condition?
Special tests: Hoffman’s

Shabat et al, 2011

- Spurling Test and imaging
Wainer et al, 2003: CPR

- Positive Spurling test
- Positive distraction test
- Ipsilateral cervical rotation < 60 degrees
- Positive upper limb tension test (median bias)

Rubinstein et al, 2007

- Wait a minute!

- Systematic review of the diagnostic accuracy of provocative tests of the neck for diagnosing cervical radiculopathy.
Electrodiagnostic testing (EDX)

- “A subjective feeling of weakness had the highest PPV, indicating that nearly 80% of all patients with subjective weakness had abnormal EDX study results.” Lauder et al., 2000
- Weakness & reflex abnormalities resulted in a 4X greater likelihood of cervical radiculopathy.
- If both weakness & diminished reflexes, 9X greater likelihood of cervical radiculopathy.
- Reflexes demonstrated a stronger association with cervical radiculopathy than w/an abnormal EDX.

EDX  Lauder et al., 2000

- When any 1 of 3 reflexes was abnormal, subjects were over 2 & a ½ times more likely to have an abnormal EDX but over 4 X more likely to have cervical radiculopathy.

- In subjects with any abnormal neurologic sign, the sensitivity improved to 84%, the PPV was 79%, but specificity was low, 44%.
Raney et al, 2009

5 clinical factors predictive of benefit:
1. peripheralization of symptoms w/lower cervical mobility testing
2. positive shoulder abduction sign
3. positive manual distraction test
4. positive upper limb tension test
5. age over 55 years

Interventions

- Mobilizations
- Manipulations
  - Cervical
  - Thoracic
- Postural ergonomics
- Motion exercises
- Cervical stabilization exercises
CPR?

Is this supposed to hurt??

Question 6

- Do you use cervical traction in patients that you feel have signs and symptoms of cervical radiculopathy?
Fritz et al, 2014

- Exercise group
- Over the door traction group
- Mechanical traction group

Waldrop, 2006, JOSPT

- Case series of 6 patients
- Intermittent cervical traction
- Thoracic manipulation
- Cervical exercises focused on stability, mobility, & endurance
Langevin et al, 2015

• Compared interventions to increase IVF to interventions to decrease IVF

• 18 in experimental group, 18 in control group

• Manual therapy and exercises are effective in reducing pain & improving function

Red flag Questions

• CERVICAL
  • VBI: dizziness, drop attacks, blurred vision, slurred speech, nausea, severe acute headache
  • Rheumatoid diseases, long term steroids, serious or recurrent respiratory infections as a child—possible laxity of craniovertebral ligaments & fragile dens
Red flag Questions

- **CERVICAL**
  - Fracture
  - Tumor
  - **Cord compression**—any tingling in arms, hands, or feet?
    Worse w/neck flexion?, unsteadiness of gait (ataxia), bladder/bowel dysfunction. With a UMN lesion the spinal micturitional reflex arc is intact, the bladder will empty automatically & there will be no sensation of bladder fullness.

Cervical considerations

- Headaches:
  - Migraines
  - Cluster
  - Cervicogenic
  - Tumors
C-spine

- HA’s associated w/brain tumors are usually bioccipital or bifrontal, intermittent, and of increasing duration.
- The HA is worse on awakening because of the differences in CNS drainage in the supine & prone positions & usually disappears soon after the patient arises. Increasing ICP intensifies the HA.
- Cervical myelopathy S & S!!

Red Flag S & S associated w/Headaches

- HA that wakes the patient up or is present upon awakening
- HA accompanied by documented elevated BP changes
- Insidious or new onset of HA
- New onset of HA w/associated neuro S & S (confusion, dizziness, gait or motor disturbances, fatigue, irritability or mood changes)
- New onset of HA w/constitutional symptoms (fever, chills, sweats)
- Episodes of blacking out during HA
- Sudden severe HA w/FLS, aching muscles, jaw pain when eating, & visual disturbances (temporal arteritis)
- No previous personal or family hx of migraine HAs

continued
Questions 7, 8 & 9

- What is Lhermitte’s sign?
- What is Hoffman’s sign?
- If present together, what do you need to consider as a possibility?

Cervical spine

- CA recurrence is not uncommon w/in the 1st 3 years after rx for CA of the head & neck.
- C-spine metastasis is most common w/distant metastases to the lungs.
Clinical S & S of Cervical Myelopathy

- Wide based spastic gait
- Clumsy hands
- Visible changes in handwriting
- Difficulty manipulating buttons or coins
- Hyperreflexia
- + Babinski
- + Hoffman
- Lhermitte’s sign
- Urinary retention followed by overflow incontinence

Kobayashi et al, 2011

- 8 item questionnaire designed to screen for cervical myelopathy
Question 10

- What degenerative joint disease usually begins in the cervical spine as neck pain?

Cervical Spine

- Rheumatoid arthritis
- Understanding who is at risk and what the risk factors are for various illnesses, diseases, and conditions will alert the therapist early on as to the need for screening, education, and prevention as part of the POC.
- Headache is a common side effect of many medications.
- Under the age of 20 or over the age of 50 are both red flag ages for serious spinal pathology.
Classification of Patients with Neck Pain

- 1. Mobility
- 2. Centralization
- 3. Conditioning & increased exercise tolerance
- 4. Pain control
- 5. Reduce headache


### Mobility

<table>
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<tr>
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<th>EXAMINATION FINDINGS</th>
<th>PROPOSED MATCHED INTERVENTION</th>
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| 1. Mobility    | - recent onset of symptoms  
                  - no radicular/referred symptoms in upper quarter  
                  - restricted ROM w/rotation or discrepancy in SB ROM or BOTH  
                  - no signs of nerve root compression or peripheralization of symptoms in the upper quarter w/cervical ROM | Interventions designed to improve ROM & decrease pain & disability  
 - cervical & thoracic spine mobilization/manipulation  
 - active ROM exercises |
Treatment Options

- Trigger Point
- Manual Therapy
- Electrotherapy
- Biofeedback
- Exercise
- Surgical


- Mobilization in isolation is not as effective.

- In between PT visits, provide patients w/a HEP that reinforces the movement that you are trying to gain!
Thoracic mobilization

- Grade C evidence in Clinical Practice Guideline.

- Sep. 2010 PTJ: combined TSM w/exercise improved disability scores however the authors did not validate their purposed CPR. Examination of a CPR to Identify Patients with Neck Pain Likely to Benefit from Thoracic Spine Thrust Manipulation and a General Cervical ROM Exercise: Multi-Center RCT. PTJ. Sept 2010; 90(9): 1239-1250.

- **Clinical Bottom line**: More evidence is needed. Evidence again supports mobilizations with exercise combined.

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**Centralization**

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<td>2. Centralization</td>
<td>- radicular or referred symptoms in the upper quarter&lt;br&gt;- peripheralization or centralization of symptoms w/ROM, or BOTH&lt;br&gt;- signs of nerve root compression present&lt;br&gt;- may have pathoanatomic diagnosis of cervical radiculopathy</td>
<td>Interventions designed to centralize symptoms and to decrease pain &amp; disability&lt;br&gt;- manual &amp; intermittent cervical traction&lt;br&gt;- repeated movements to centralize symptoms</td>
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Centralization group

- Note: Goal is to centralize the pain. The patient needs to know to avoid peripheralization.
  - Specific repeated movements to promote centralization are NOT more beneficial in reducing disability when compared to other forms of intervention. (C)
  - Bottom line: According to evidence, repeated motions are not as effective as other interventions.

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| Conditioning & Increased Exercise Tolerance | - lower pain & disability scores  
- longer duration of symptoms  
- no signs of nerve root compression present  
- no peripheralization or centralization during ROM | Interventions designed to improve endurance, strength, and flexibility |
|  |  | - Strengthening & endurance exercises for the muscles of the neck & upper quarter |
|  |  | - Aerobic conditioning exercises |

Conditioning & Increased Exercise Tolerance
Stabilization of Deep Neck Flexors

- The deep neck flexors are purported to be significant contributors to the stability of the cervical spine. Krout et al. Arch Phys Med Rehabil. 1966;47:603-611.


Domination of the SCM
Treatment (Biofeedback)

- Low load endurance exercise to train muscle control of the cervicoscapular region
- First taught to perform slow and controlled craniocervical flexion action then trained to be able to hold progressively increasing ranges of craniocervical flexion using feedback from an air filled pressure sensor placed behind the neck.

Stabilization

- Mobilize hypomobile segments
  - Can NOT extrapolate protocol from lumbar spine

- Retrain head on neck awareness Treleaven 2016
  - Sensorimotor/proprioceptive control

- Enhance strength and endurance of local stabilizing muscles
  - LONGUS COLLI
### Pain Control

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<td>4. Pain Control</td>
<td>high pain and disability scores, very recent onset of symptoms, symptoms precipitated by trauma, referred or radiating symptoms extending into the upper quarter, poor tolerance for examination or most interventions</td>
<td>Interventions designed to decrease pain &amp; disability &amp; to permit further examination - gentle active ROM w/ in pain tolerance - ROM exercises for adjacent regions - physical modalities as needed - activity modification to control pain</td>
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### Intention of movement

- Thinking and intention
- Movement will occur in the cervical spine
- Increased activity in the agonist muscles
  - Eyes only
  - Head only
  - Eyes and head
  - Challenge these skills
Reduce Headache

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<td>5. Reduce Headache</td>
<td>unilateral headache w/onset preceded by neck pain - headache pain triggered by neck movement or positions - headache pain elicited by pressure on posterior neck</td>
<td>Interventions designed to reduce headaches - cervical spine mobilization/manipulation - strengthening of neck &amp; upper quarter muscles - postural education</td>
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Cervical Headache

- **Contraction of the deep neck flexors muscles was significantly weaker in the cervical headache group**

- Jull 2002 compared a control group to a group receiving mobilization, strengthening of the DNFs and scapular muscles:
  - At 7 and 12 weeks, the combined exercise and manual therapy group was improved.
  - Also, significant reductions in HA symptoms that were maintained at a 1 year follow-up.

  ➢ **Clinical Bottom Line:** Exercise and Manual therapy combined to reduce pain. (A)
Cervicogenic Headache

- A referred pain perceived in any part of the head caused by a primary nociceptive source in the musculoskeletal tissues innervated by cervical nerves.
- World Cervicogenic Headache Society

Cervical spine

- Cervicogenic headaches originate from C1-4 & are associated with chronic tension or acute whiplash injury, intervertebral disc disease, or progressive facet joint arthritis.

- HA can be a symptom of neurological impairment, hormonal imbalance, neoplasm, side effects of medication.

- HA may be the ONLY symptom of HTN, cerebral venous thrombosis, or impending stroke. Sudden severe HA is a classic symptom of temporal arteritis, a condition that can lead to blindness.
VBI

Questions??

Count the black dots! :o)
Out of here...

References

- Fritz JM, Thackery A, Broman GP, Childs JD. Exercise only, exercise with mechanical traction, or exercise with over-door traction for patients with cervical radiculopathy, with or without consideration of status on a previously described subgrouping rule: a randomized clinical trial. JOSPT 2014;44(2):45-57.
References


- Waldrop MA. Diagnosis and treatment of cervical radiculopathy using a clinical prediction rule and multimodal intervention approach: a case series. JOSPT 2006;36:152-159.