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Differential Diagnosis of Thoracic Spine/Pain

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Objectives

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

- recognize 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 determine a patient with red flags presenting with thoracic pain.
- interpret characteristics and clinical patterns in a patient with thoracic pain.
Question 1

0 How often do you evaluate a patient with thoracic pain?
0 A. more than 5 in a month
0 B. more than 15 in a month
0 C. less than 5 in a month
0 D. all the time

? 2

0 In the patients that you treat for thoracic spine pain, what is the most likely cause of their pain?
Thoracic pain of MS origin

- Thoracic spine pain accounts for 15 to 20% of all back pain syndromes
- There are multiple origins of pain in this region to include:
  - Facet joints
  - Costovertebral joints
  - Costotransverse joints
  - IV disks

MS manifestations

- Pain
- Numbness
- Weakness
- Paraesthesias
Question 3

- What spinal level do you feel is most commonly considered the problem level for patients that c/o thoracic pain of a MS origin?

Question 4

- Do you think posture plays a role in your patient’s c/o thoracic spine pain?
- If so, how?
Role of posture?

T4 syndrome

- Unilateral or bilateral glove & stocking distribution of paraesthesia
- Pain at night or early AM in UE’s and thorax with no neuro signs
- Often found in sedentary repeated, flexed/stooped seated posture (occupational hazard!)
Hyperkyphosis in the t-spine

- Excessive anterior curvature in the t-spine.
- Longitudinal cohort studies have reported an increase in total # of fractures over 4 years.
- Katzman et al reported on 3,038 women finding for each 10 degree increase in kyphosis angle there was a 22% increase in annualized rate of incident of vertebral fracture.

Costochondritis

- Refers to pain in the costochondral articulations w/o swelling.
- Over 40 & female
- Tends to affect the 2nd, 3rd, 4th & 5th costochondral joints
- Trauma or repetitive motion in their history
- Sharp pain along sternum; burning sensation.
Tietze syndrome

- Sudden or gradual onset of upper anterior chest pain
- Pain/tenderness of costochondral joint(s)
- Bulbous swelling of the involved costal cartilage
- Mild to severe chest pain that may radiate to the L shoulder & arm
- Pain aggravated by deep breathing, recumbency, or exertion

Slipped rib syndrome

- Most common in the lower ribs with hypermobility
- Common in middle aged years
- Pain is worse with slump sitting or Sbing to affected side
- Anterior ribs sublux, impinging on intercostal nerve...ouch!!
Scheuermann disease

- Most common causes of structural spinal hyperkyphosis in adolescents
- 2 types have been described
  - Thoracic
  - Thoraco-lumbar
- Diagnosis is based on clinical and radiological presentation
Scheuermann disease

- Manifests as vertebral wedging, endplate irregularity, diminished anterior vertebral growth, Schmorl’s nodes, narrowing of the IV disk spaces & premature disk degeneration

- SD is most common between the ages of 12 and 15

Trigger points (example)

- Anterior scalenes:
  - Ipsilateral sternal pain
  - Anterior chest wall pain
  - Breast pain
  - Vertebral border of scapula pain
  - Radiating pain to thumb & index finger
Clinical exam along with history

- Dermatomes
- Myotomes
- Reflexes
- Special tests

Dermatomes
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.

- **Stimulus**
- First-order neuron
- Second-order neuron
- Third-order neuron
- Primary sensory cortex
- Thalamus
- Nucleus Gracilis
- Nucleus Cuneatus
- Fasciculus Cuneatus
- Fasciculus Gracilis

**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
**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).

**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: 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: Behavioral Description

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

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Fasciculus Cuneatus: Neuroanatomical Description

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Second-order neurons
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Axon: decussates in the medulla and projects to the contralateral thalamus (ventral posterolateral 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
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
0 What muscles can you test to evaluate if a patient has a thoracic disc problem?

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).

Stretch Reflex

- Afferent
- Muscle Spindle
- Alpha MN
- Stretch

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What reflex would you do if you were evaluating a patient with thoracic spine pain?

Special tests: Hoffman’s

(Insert hoffman video here)
Somatic disorders

- MS syndromes in which symptoms are caused by nociceptive stimulation of pain-sensitive structures. The origin of somatic pain is mechanical and/or chemical stimulation of nerve endings.
- Pain can be localized or referred & difficult to point-localize.

Somatic pain symptoms

- Location: typically unilateral
- Quality: achy, deep, sharp, pulling, sore, stiff
- Character: local pain attributable to an activity or underlying pathology
- Onset: sudden or gradual. If sudden, then associated w/acute overload stress
- Duration/frequency: intermittent to constant
- Agg. Factors: typically exacerbated w/specific movements
Radicular disorders

- Neurogenic disorder in which S&S are caused by damage or irritation of the spinal nerves or spinal nerve roots. The origin of S&S is mechanical and/or chemical and due to a block in conduction vs. stimulation of nerve endings.
- Radicular =’s LMN S&S (weakness, atrophy, hyporeflexia & sensory changes such as paraesthesia and/or numbness)
- Radicular and somatic occur concurrently w/somatic pain disorders

Radicular symptoms

- Described as SHOOTING or lacerating and is typically felt in a relatively narrow band about 4 cm wide; it is often combined w/other radicular symptoms such as tingling, numbness, & burning sensations.
What's the diff b/n radicular vs somatic referred pain?

- Radicular result from a block in conduction rather than nociceptive stimulation of pain-sensitive structures (spinal nerve or nerve root).
- The distribution of radicular symptoms is NOT always distinctive.
- Radicular pain from a given nerve root doesn’t always follow a consistent distribution.
- All radicular disorders don’t result in referred pain.
- Radicular symptoms don’t always extend to the distal portion of the involved dermatome!

History & Past History

- Was the onset sudden, rapid or gradual?
- MOI?
- Onset time for symptoms, swelling & stiffness
  - Six weeks to six months of increasing backache, often in an older client, may be a signal of lumbar metastases, especially in a patient w/a hx of CA. 
    Goodman

- Past history
- Previous episodes, frequency & outcome
- Previous interventions & success rate
Thoracic observation

- Gibbus—hump back. Produced by an anterior wedging of 1 or 2 thoracic vertebrae as a result of infection, fx, or congenital anomaly.

- The appearance of increased kyphosis in the young could be the result of Scheuermann’s dx. The degree of curvature of the spine has also been found to be diurnal, w/a slight flattening of thoracic kyphosis occurring overnight.

- T4-T7 dysfunction causes pseudoanginal pain

Observation

- Gait – general observations of
  - Speed of motion & caution w/changes of position
  - Antalgic strategies
- Standing & sitting posture
- Deformity, major asymmetries, scoliosis
- Lateral, rotated or flexion shift
- Wasting, swelling, bone prominence
- Skin
  - Scars, red, shiny, Fawn’s beard
Behavior of symptoms

- Irritability—how easily is it made worse? Or how quickly does it settle? (Maitland)
- How long with daily symptoms?
- What increases or decreases symptoms?
- Is there a posture or position that relieves pain?
- 24 hour variation—morning stiffness or evening
- Night pain: present with moving or static postures

Special Questions

- **THORACIC**
  - Cord symptoms—ataxia, limb numbness & weakness, potential for bowel & bladder disturbances
  - Fracture or tumor—pain with deep breath, cough, sneeze; osteoporosis
  - Visceral referral
  - Compression fractures in osteoporotic patients & athletes (cyclists as an example)
Motion testing

- When seen early in the course of symptoms, neck or back pain of a systemic or viscerogenic origin is usually accompanied by FULL & PAINLESS ROM W/O LIMITATIONS!!

- When the pain has been present long enough to cause muscle guarding & splinting, then subsequent biomechanical changes occur.

video

- Insert video 0431
Biomechanics of t-spine

- Panjabi termed this the functional spinal unit
- Ribs 1 through 7 posteriorly rotate with inhalation and anteriorly rotate with exhalation
- A thoracic ring consists of 2 adjacent vertebrae, associated costocartilage, ribs that articulate with the vertebrae, the manubrium, the sternum and all joints connected to these bones.

Anatomy

Lee DG. JMMT 2015
video

- Insert video 0429 here

Anatomy/flexion

Flexion

Lee DG. JMMT 2015
Anatomy/extension

Lee DG. JMMT 2015

video

0 Insert video 0429 again here
Clinical biomechanical model

Lee DG.
JMMT 2015

- Vertebromanubrial—1st 2 thoracic vertebra, ribs 1 & 2 and the manubrium
- Vertebrosternal—T3-T6, 3rd to 6th ribs and sternum
- Vertebrochondral—T7-T10 with 7 to 10th ribs
- Thoracolumbar—T11 & T12 vertebra & 11th & 12th ribs

video

- Insert video 0427
Flags

The use of Flags are not universal; not shared by all health care professionals. They give us, as therapists, the idea of BE AWARE. It is only when we reenforce this with other POSITIVE history and tests to confirm our findings.

It has been reported that only 5% of physicians assess patients for “red flags”. Bishop PB, Wing PC. Spine Journal 2003.

BE AWARE vs. BEWARE

Exam Red Flags (Goodman & Synder)

- **PAST MEDICAL HX**
  - Personal or family hx of CA
  - Recent infection (last 6 weeks) followed by neuro signs, joint pain, or back pain
  - Recurrent colds/flu w/cylical pattern
  - Recent hx of trauma
  - Hx of immunosuppression
  - Hx of injection drug use

- **RISK FACTORS**
  - Age
  - BMI
  - Gender
  - Race/ethnicity
  - Tobacco use
  - Substance use/abuse
  - Occupation
  - Domestic violence
  - Hysterectomy/oophorectomy
  - Sedentary lifestyle
  - Overseas travel
  - Exposure to radiation
  - Multiple sexual partners
Common Red Flags Associated w/BACK PAIN of SYSTEMIC ORIGIN!!!!

- Age less than 20 or over 50
- Previous hx of CA
- Constitutional symptoms (fever, chills, unexplained weight loss)
- Recent UTI
- Immunocompromised condition (autoimmune dx, corticosteroids, transplant recipient)
- Failure to improve w/conservative care (4-6 weeks)
- Pain is not relieved by REST or RECUMBENCY
- Severe, constant nighttime pain
- Progressive, neurologic deficit; saddle anesthesia
- Back pain accompanied by abdominal, pelvic or hip pain
- History of falls or trauma (screen for fx, osteoporosis, domestic violence, alcohol use)
- Significant AM stiffness w/limitation in all spinal movements (ankylosing spondylitis or other inflammatory disorder)
- Skin rash (inflammatory disorder, Crohn’s dx, ankylosing spondylitis)

Thoracic spine

- T-spine pain can be referred from the kidneys, biliary duct, esophagus, stomach, gallbladder, pancreas & heart.
- Must look for the cause of the thoracic pain at the level above & below the area of pain/dysfunction.
- Systemic origins are usually accompanied by constitutional symptoms
Visceral pain symptoms

- Location: uni or bilateral
- Quality: knifelike, boring, DEEP
- Character: unrelieved by rest or changes in position
- Onset: recent or sudden
- Duration/frequency: constant or intermittent based on the organ/system

Associated S & S

- If the therapist only focuses on the c/c of back, neck, shoulder, or other MS pain & does not ask about the presence of symptoms anywhere else, an important diagnostic clue may be overlooked.
- Symptoms may include:
  - Fatigue
  - Dyspnea
  - Nausea/vomiting
  - Sweating after only minor exertion
  - GI symptoms like diarrhea
Red flag

- Chest pain associated with increased activity is a red flag for possible CV involvement. In such cases, the onset of pain is not immediate but rather occurs 5 to 10 minutes after activity begins. Lag time is used as a screening tool: MS—immediate chest pain occurs with use; Cardio—CP occurs 5-10 minutes after activity.

Musculoskeletal

- 20-25% of noncardiac CP has a MS basis.
- CP can occur as a result of cervical spine disorders because nerves originating as high as C3 & C4 can extend to the nipple line.
- MS disorders such as myalgia associated with muscle exertion, myofascial TrPs, costochondritis or xiphoiditis can produce pain in the UEs & chest.
Thoracic spine considerations

- Pain of musculoskeletal origin should be associated with thoracic movements or postures

- Thoracic pain can also be referred from the kidney, biliary duct, esophagus, stomach, gallbladder, pancreas, & heart.
  - Peptic ulcers occur in between T8-T10.
  - Duodenal ulcers refer to T5.

- Tumors occur most often in the T-spine because of its length, the proximity to the mediastinum, & direct metastatic extension from lymph nodes w/lymphoma, breast or lung cancer.

Chest pain

- Clinical exam
  - Watch for uneven pulses from side to side, diminished or absent pulses, elevated BP, or extreme hypotension.

  - Auscultation for breath or lung sounds & chest percussion may provide additional Cardiopulmonary clues.
Chest pain patterns

- Chest pain may be derived from dermatomes T1-12, the pleura, the trachea, and main airways, the mediastinum & the abdo viscera. From an embryologic view, the lungs are derived from the same tissue as the gut so problems can occur in both areas causing chest pain.

Chest pain patterns

- Certain chest pain patterns are more likely to point to medical vs MS cause. For example, pain that is positional or reproduced by palpation is not as suspicious as pain that radiates to one or both shoulders or arms or that is precipitated by exertion.
Chest pain

- Parietal or somatic chest pain is the most common systemic chest discomfort encountered in a PT practice.

- Parietal pain refers to pain generating from the wall of any cavity, such as the chest or pelvic cavity.

Parietal chest pain

- Irritation of intercostal nerves results in pain in the chest wall that is usually described as knifelike & is sharply localized close to the chest wall.

- Thoracic viscera pain & true chest pain is felt in the chest wall, but visceral pain is referred to the area supplied by the upper 4 thoracic nerve roots.

- Extensive disease may develop w/in the body cavities w/o the occurrence of pain until the process extends to the parietal pleura.
Pleural pain

- May be aggravated by any respiratory movement involving the diaphragm such as sighing, deep breathing, coughing, sneezing, laughing or the hiccups.

- Palpation usually does not reproduce pleural pain; change in position does not relieve or exacerbate the pain. In some cases of pleurisy, the pt can point to the painful spot but deep breathing (not palpation) reproduces it.

T-spine

- Tumors occur most often in the t-spine.

- GI: look for NSAID use & blood in the stools.
- Cardiac, pulmonary, renal & GI disorders can cause scapular pain.
- Pancoast tumors of the lung refer pain through C8-T1 area.
Chest pain not caused by a MI

- Physicians use the 3 P’s:
  - Pleuritic pain (exacerbation by deep breathing is more likely pulmonary in nature)
  - Pain on palpation (MS cause)
  - Pain w/changes in position (MS cause)

video

- Insert Murphy’s test for the liver video
Cancer

- Irritation of an intercostal nerve from rib metastasis produces burning pain that is unilateral & segmental in distribution.
- Sensory loss or hyperesthesia over the affected dermatomes may be noted.
- Meningiomas are common in the T-spine.

Anxiety

- Pain may be sharp, intermittent, or stabbing & located in the region of the L breast.
- The area of pain is usually no larger than the tip of the finger but may be as large as the pt’s hand.
- Often associated w/hyperesthesia of the chest wall. Not reproduced w/palpation or activity. It may be of variable duration, lasting no longer than a second or for hours or days. Unrelated to effort or exercise.
CP caused by anxiety

- Dull, aching discomfort in substernal region & in anterior chest
- Sinus tachycardia
- Fatigue
- Fear of closed in places
- Diaphoresis
- Dyspnea
- Choking sensation
- Hyperventilation: numbness & tingling of hands & lips

Cholelithiasis

- 5th leading cause of hospitalization for adults
- Increases with age
- TTP over the gallbladder & tip of the 10th rib radiating from right anterior to 11th & 12th rib
- Usually accompanied by constitutional symptoms
Manipulation

IN
- Peer reviewed
- 1950 to 2015
- Case reports or case series
- TJM as an intervention

OUT
- AE w/out TJM
- Systematic or lit review
- Other than English or Spanish

Manipulation: Puente dura and O’Grady JMMT 2015
Adverse Events

- Most common was injury to spinal cord (7/10)
- Next was pneumothorax and hemothorax (2/10)
- CSF leak (1/10)

**Most common Post TJM symptoms:**
- Progressive weakness in LE’s
- Thoracic pain
- Nausea
- SOB at rest
- Neck stiffness
- Photophobia
- Severe HA relieved by lying supine

AE in review

- Chiropractors involved in 70% of AE cases
- An osteopathic physician and a PT were involved in the remaining 30% of AE cases
- Max peak forces of 125 lbs of force to t-spine

- All of the cases were published by neurosurgeons or emergency medicine physicians providing care after the TJM. Unknown if contraindications or precautions to TJM were violated in these reported cases.
Contraindications to TJM

- Bony issues
- Tumor e.g. metastatic disease
- Infection, e.g. TB, osteomyelitis
- Metabolic, e.g. osteomalacia, osteoporosis
- Congenital e.g. dysplasias, congenital fusions
- Iatrogenic e.g. long term corticosteroid meds
- Surgical fusions, recent surgery
- Inflammatory e.g. RA, AS, acute soft tissue injury, connective tissue disease, synovial cysts
- Trauma e.g. fracture, dislocation, ligamentous rupture, instability
- Neuro issues
- Any patho that may affect the neuro system
- Acute cervical, thoracic or lumbar myelopathy
- Spinal cord compression
- Cauda equina syndrome
- Nerve root compression with increasing neuro deficit, bilateral hyper-reflexia/sensory loss

Contraindications to TJM continued

- Sudden vomiting/nausea/vertigo
- Vascular issues
- Any patho that may have led to vascular compromise
- VBI or cervical artery abnormalities
- AAA
- Bleeding diatheses, e.g. hemophilia, anticoagulant therapy
- Angina pectoris
- Untreated cardiac insufficiency, untreated cardiac dysrhythmias
- Acute abdominal pain with guarding
- Any matter that may increase the risk of harm to the patient
- Lack of adequate subjective and objective examination by clinician
- Lack of consent from the patient
Precautions to TJM

- Adverse reaction to previous TJM
- Inflammatory joint processes
- Minor osteoporosis
- Disc herniation and disc protrusion
- Spondylolisthesis
- Hypermobility or ligamentous laxity
- Arterial calcification
- Arterial hypertension
- Serious DID
- Growing children
- Serious kyphosis and scoliosis
- Herpes zoster on the thoracic spine
- Vertigo
- Systemic infections
- Psychological dependence upon manipulation
- Pain with a psychological overlay
- No change or worsening of symptoms after multiple manipulations

TJM to the t-spine

- Transient or unwanted effects occur in 60.9% of all thrust joint manipulations

- Serious adverse effects can and do occur in manipulation of the t-spine.

- All the more reason to know the red flags associated with treating a patient w/thoracic spine pain.
What is the physician referring to when they write "cva" in a chart? Where is it? If there is tenderness there, where else will the patient more than likely c/o pain?

Insert cva video
Special Questions

- Medical screening? Imaging?
- Meds: present & previous for this & other medical conditions
- Concerns regarding manual therapy:
  - Anti-coagulant therapy, long term steroid use
  - Osteoporosis
  - Past hx of CA
  - Vascular or neural compromise
  - General health

? 

- Should a pulmonary condition be suspected? A pt presents w/a sharp, right lateral thorax pain on inhalation (T4-T7) secondary to a MVA that occurred 5 weeks ago. During sustained inhalation, the symptomatic pain can be eliminated w/R SB & exacerbated w/L SB. Additional symptoms include intercostal tenderness & trigger points noted in the involved area of dysfunction.
- Whatcha thinking?
Medication Concerns

- Long term use of corticosteroids can lead to vertebral compression fractures.
- Fluoroquinolones (antibiotics) can cause neck, chest, or back pain.
- Headache is a common side effect of many medications.

Position of comfort

- Typically, systemic back pain is not relieved by recumbency. Bone pain of metastasis or myeloma tends to be more continuous, progressive, and prominent when lying down.
- **Beware of the client w/acute backache who is unable to lie still.** Almost all clients with regional or nonspecific backache seek the most comfortable position (usually recumbency) & stay in that position.
- In contrast, the client w/systemic backache tends to keep moving trying to find a comfortable position.
Systemic backache

- In particular, visceral diseases, such as pancreatic neoplasm, pancreatitis, and posterior penetrating ulcers, often have a systemic backache that causes the client to curl up, sleep in a chair, or pace the floor at night!!
- Back pain that is unrelieved by rest or change in position, or pain that doesn’t fit a MS pattern should raise a red flag.

Systemic backache & Night pain

- Systemic back pain may get worse at night, especially when caused by vertebral osteomyelitis, septic discitis, Cushings disease, osteomalacia, primary & metastatic cancer, Pagets disease, ankylosing spondylitis, or tuberculosis.
- Long standing NIGHT PAIN unaltered by positional change suggests a space-occupying lesion, such as a TUMOR!
We have covered...

- A lot!!
- Red flags associated with the thoracic spine
- NMS Conditions that require referral that are not w/in the therapist’s scope of practice
- Conditions in the literature that require your attention (MS & NMS)

Any questions??
Thank YOU!!!