EVALUATE, TREAT AND WHEN TO REFER

RED FLAGS

Mid-Atlantic Occupational Regional Conference and Environmental Medicine
October 6, 2018

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Where Are We Going

Anatomy
Exam/History
Treatments
Common Pathologies
Surgical Options/Advances
CERVICAL SPINE ANATOMY
CERVICAL SPINE ANATOMY
CERVICAL SPINE ANATOMY
CERVICAL SPINE ANATOMY
Cervical Spine Neural Anatomy
Spinal Cord Anatomy
Spinal Cord Anatomy

Figure 4

- Spinal Cord Ends at L2 and become Cauda Equina
- Cauda Equina: Bundle of Lumbar and Sacral Nerve below Level L2 Lumbar Vertebrae
- Sciatic Nerve
PLAIN XRAYS
COMPUTED TOMOGRAPHY
CT SCANS
CT SCANS
C1-C2
NORMAL

Powers ratio = 3.21 : 5.02
A ratio greater than 1.0 suggests ligamentous instability

Basion ➔ 5.02 cm ➙ Opisthion
Anterior arch of C1 ➔ 3.21 cm ➙ Posterior arch of C1

VirtualMedStudent.com
MRI VS CT
MRI
AXIAL CERVICAL NORMAL
LUMBAR SPINE ANATOMY

Lumbar Spine: Lateral View

Intervertebral Disc

- Intervertebral disc
- Endplate cartilaginous layer
- Endplate bony layer
LUMBAR SPINE ANATOMY
BUILDING BLOCKS OF THE LUMBAR SPINE
INTERVERTEBRAL DISC

-Annulus Fibrosus
-Nucleus Pulposus
Ligaments: Lumbar Spine
Lateral View
-sagittal
-cortical bone
-cancellous bone
Lumbar Spine Neuroanatomy

Neuroforamen
- Lateral view

Spinal Cord/Conus/Cauda Equina
- Dural tube
- Conus medullaris
- Cauda equina (dorsal and ventral nerve roots)
- L1 pedicle (cut)
- L2 pedicle (cut)

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Lumbar Spine XRAYS
Computed Tomography
CT
Computed Tomography
CT
MRI
Sagittal

Normal MRI
This is an example of a normal MRI (except for the small disc bulge at L1-2). Note the appearance of the normal disc. A normal disc is well hydrated and has a whitish appearance on the MRI. The outer portion of the disc is the tough annulus which appears black. The spinal canal is wide and cylindrical.

- Nucleus of Discs with normal whitish appearance
- Annulus of disc with normal solid black appearance. There are no cracks or herniations posteriorly.
- Smooth cylindrical shape of spinal cord without any disc bulges on the cord.
- No Posterior Bone Spurs are present that would cause cord compression.
MRI
SAGITTAL
MRI
AXIAL

- Cortical rim
- Cancellous bone
- Body
- Pedicle
- Transverse process
- Superior articular process
- Lamina
- Vertebral foramen
- Spinous process

- Spinal Nerves
- Vertebral body
- Spinal Canal
- Muscle
- Back
- Skin

Section of lumbar spine showing normal spinal canal lumen
OTHER IMAGING TESTS

- Myelograms
- Post myelogram CT scan
- Discograms
- Contrasted MRIs
- Standing MRIs
- Bone Scans
- EMG/NCS
Treatment of Acute Low Back Pain

“OUT OF ORDER”
MANAGEMENT OF ACUTE BACK PAIN
Management of Acute Back Pain
“NO RED FLAGS”

DOOR NUMBER 1

- Activity Modification
- Oral Steroids
- NSAIDS
- Muscle Relaxants
- Physical Therapy
- Pain Medications/Opioids
- RE ASSURANCE!!
Management of Acute Back Pain
“NO RED FLAGS”

Door Number 2

- Pain Management
- Epidural Steroids
- Facet Injections
- Medial Branch Blocks
- SI Joint Injections
- Trigger Point Injections
- Occipital Nerve Injections
Management of Acute Back Pain

Door Number 3
- Spinal Surgeon

When to Refer
- Failure to respond to Door Number 1
- Failure to respond to Door Number 2
- RED FLAGS
ACUTE NECK/BACK PAIN
HISTORY AND PHYSICAL
HISTORY FOR ACUTE BACK PAIN

HISTORY OF INJURY
• MVA
• FALL IMPACT
• TWIST
• LIFTING/STRAIN
• IMPACT
• “ENERGY of INJURY”

• PAST HISTORY
• Malignancy, infections, surgery, medical, osteoporosis

HISTORY OF SYMPTOMS
• Onset to event
• Severity 0-10
• Weakness
• Lhermittes
• Gait
• Bowel Bladder
• Saddle Paresthesias
• Unilateral/Bilateral
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Motor Vehicle Accident-Neck Pain
GET XRAY

- NORMAL
- LATERAL

Lines
- anterior vertebral
- posterior vertebral
- spinolaminar
- posterior spinous

Prevertebral thickness
- 7mm at C2
- 2cm at C7
CERVICAL SPINE
XRAY RED FLAGS
Soft Tissue Swelling
CERVICAL SPINE
XRAY RED FLAGS
ALIGNMENT AND SOFT TISSUE
Lumbar Spine
X-ray Red Flags
“Energy of Injury”

- Compression Fracture
- Superior/Inferior
- INTACT Posterior Cortex
Lumbar Spine Xray
Red Flags
“Energy of Injury”

- Burst Fracture
- Pedicle Widening
- Bone Retropulsion
Lumbar Spine Xrays
Red Flags
Plain Xrays

- CHANCE FRACTURE
- MVA-seat belt injury
- Compression/Flexion
- Boney/Soft Tissue
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History of Symptoms
Red Flags
Lhermitte’s

- Symptom/Exam
- Spinal Cord Sign
- “I feel electrical shocks”
History of Symptoms
Red Flags
Gait and Clumsiness

- Symptom/Exam
- “I am falling over when I walk”
- “I am dropping things”
- Cervical Myelopathy
History of Symptoms
Red Flags
“CAUDA EQUINA”

Cauda Equina Syndrome – Red Flag Symptoms

1. Saddle Anaesthesia: A loss of feeling or numbness between the legs and/or back passage and/or genitals.
2. Bladder Disturbance: Difficulty controlling urination, loss of sensation.
3. Bowel Disturbance: Inability to control bowel movements, a loss of sensation and/or constipation.
4. Sexual Problems: Inability to maintain erection or ejaculate, loss of sensation during intercourse.
5. Nerve Root Pain: Combination of pain, numbness or weakness in back and legs and/or changing temperature sensations and/or spasms in the lower limbs.
Cauda Equina Syndrome-History

Low Back Pain
Saddle Hypoesthesia
Bowel/Bladder Dysfunction
HISTORY FOR ACUTE BACK PAIN

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• Saddle Paresthesias
• Unilateral/Bilateral
Past History
Red Flags
Awareness-Suspicion

- Inflammatory Arthritis
- Malignancy
- Previous Spine Surgery
- Infection History
- Osteoporsis
Where Are We Going
“Where Have We Been”

Anatomy
Exam/History
Treatments
Common Pathologies
Surgical Options/Advances

OFF WE GO
Lumbar Spine Exam
Red Flag-Weakness

<table>
<thead>
<tr>
<th>Root</th>
<th>Muscle/Action</th>
<th>Sensation</th>
<th>Reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1, L2</td>
<td>Hip flexion</td>
<td>Inguinal crease (L1), anterior thigh (L2)</td>
<td>None</td>
</tr>
<tr>
<td>L2, L3</td>
<td>Knee extension</td>
<td>Anterior thigh (L2), anterior thigh just above knee (L3)</td>
<td>None</td>
</tr>
<tr>
<td>L4</td>
<td>Ankle dorsiflexion</td>
<td>Medial leg and foot</td>
<td>Knee jerk</td>
</tr>
<tr>
<td>L5</td>
<td>Extensor hallucis longus</td>
<td>Lateral leg, foot dorsum</td>
<td>none</td>
</tr>
<tr>
<td>S1</td>
<td>Ankle plantarflexion</td>
<td>Lateral foot, plantar foot</td>
<td>Ankle jerk</td>
</tr>
</tbody>
</table>
Signs and Symptoms
Radicular Pain
Weakness
Numbness
Back Pain
Straight Leg Raise

AXIAL BACK AND/OR
RADICULAR PAIN
Cauda Equina Syndrome-Exam

Decreased Perineal Sensation

Decreased Rectal Tone

Depressed Reflexes
  Knee
  Ankle
  BC Reflex

REFER
CAUDA EQUINA SYNDROME

- Low back pain
- Sciatica
- Saddle and perineal hypoesthesias
- Decrease anal tone
- Urinary dysfunction

Pinched cauda equina nerves cause pain
Numbness in inner thighs and buttocks
Cauda Equina Syndrome - Pathology

Compression of Cauda Equina

- Disc
- Tumor
- Trauma
- Epidural Process
  - Hematoma
  - Abscess

NOT THE SPINAL CORD

REFER
EXAM
Cervical Spine Innervations
Refer for Weakness

<table>
<thead>
<tr>
<th>DERMATOME TESTING POINT</th>
<th>MYOTOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 lateral antecubital fossa just proximal to elbow joint</td>
<td>elbow flexion – biceps and brachialis biceps reflex</td>
</tr>
<tr>
<td>C6 dorsal proximal phalanx of thumb</td>
<td>wrist extension – extensor carpi radialis longus and brevis biceps reflex supinator reflex</td>
</tr>
<tr>
<td>C7 dorsal proximal phalanx of middle finger</td>
<td>elbow extension – triceps triceps reflex</td>
</tr>
<tr>
<td>C8 dorsal proximal phalanx of little finger</td>
<td>middle finger flexion – flexor digitorum profundus (distal phalanx)</td>
</tr>
<tr>
<td>T1 medial antecubital fossa just proximal to elbow joint</td>
<td>little finger abduction – abductor digiti minimi, interossei</td>
</tr>
</tbody>
</table>
Deep Tendon Reflexes

Red Flags

• Asymmetry
• Brisk

MUSCLE STRETCH REFLEXES
(DEEP TENDON REFLEXES)

(GRADED 0-5)

0 - Absent.
1 - Present with reinforcemenent.
2 - Normal
3 - Enhanced
4 - Unsustained clonus
5 - Sustained clonus
Physical Exam
Red Flags

Radiculopathy
- Spurling’s sign
- Arm on the head sign

Lhermitte’s Sign
Electric shock sensation which occurs with neck flexion and often radiates down the spine.

Radiculopathy VS. Myelopathy
Refer
Upper Motor Signs
Myelopathy
Red Flags

Hoffman
Babinski
Clonus
Where Are We Going
“Where Have We Been”

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OFF WE GO
Cervical Disc Herniation
Cervical HNP
Clinical - Radiculopathy or Myelopathy
Neck Pain
Plain x-rays often normal
MRI Best
Myelo/CT option
Anterior Cervical Decompression and Fusion (ACDF)

Cervical Disc Herniation with Surgical Fusion

- **Post-accident Condition**
  - Spinal cord
  - Vertebrae (e.g., C4, C5, C6)
  - C6-7 disc herniation with degenerative changes and osteophytes

- **Sagittal view of cervical spine**

- **A.** An incision is made across the neck at the C6 level.

- **B.** The herniated C6-7 disc is exposed and removed.

- **C.** The C6 and C7 vertebral endplates are debried, removing the osteophytes.

- **D.** A drill hole is created spanning C6-7 disc space.

- **E.** A bone plug is driven into the drill hole to complete the fusion.
ACDF
CERVICAL DISC ARTHROPLASTY
Lumbar HNP MRI

L5-S1 Sagittal

L5-S1 Axial

L-5 Disk Level
Lumbar Spine Discectomy
Lumbar Discectomy Schematic

L4-5 and L5-S1 Lumbar Laminotomy and Discectomy Procedure

Pre-operative Condition

- Spinal cord
- Sphenoid process
- Dura mater
- Cauda equina
- Disc bulge
- Herniated disc with compression of nerve root
- Sagittal view
- S1
- Sacrum

A. An incision is made into the skin back to expose the lumbosacral region.

B. After exposed, the lumbar bone is removed from the right side.

C. The ligamentum flavum is removed exposing the neural elements.

D. The herniated disc material is removed decompressing the neural elements.
Lumbar Stenosis

- Normal 3D Schematic
- Stenosis = Narrowing
Lumbar Stenosis
MRI Sagital
Lumbar Stenosis
MRI Axial

• Normal
• Stenosis
Lumbar Stenosis
Laminectomy
Vertebral Body Compression Fracture (VCF)

- Normal:
  - Spine shorter, tilted forward
  - Wedge-shaped

- Fractured:
  - Depressed endplate(s)
  - Spine shorter, tilted forward
KyphX® Introducer Tool Kit

Allows precise, minimally invasive access to the vertebral body and provides a working channel.
KyphX® IBT Inflation

Reduces the fracture, compacts the bone, and may elevate the endplates
Leaves a defined cavity within the vertebral body
Case Study

Patient: 55 YO Male
Diagnosis: Secondary osteoporosis
Fracture Reduced: L-1, 3 day old
LUMBAR FUSION
WE HAVE COME A LONG WAY
GOALS OF LUMBAR FUSION

• Stabilize Spine
• Take Away Motion
• Re-Create Anatomy
• Nerve Decompression
• **TAKE AWAY PAIN**
• Prevent Recurrent Problems
Traditional Lumbar “Open” Fusions Still Has a Place

**Figure 1.** Photograph demonstrating traditional open posterior wound for segmental fixation.
Minimally Invasive TLIF/PSF
Transforaminal Interbody Fusion/Posterior Spinal Fusion
MIS TLIF/PSF vs. OPEN
X-treme Lateral Interbody Fusion
XLIF
Targeting: Localization
Caudal –Left Lateral UP-Cranial

Lateral Access
Retractor Placement
Important AP/Lat Flouro Views
Degenerative Disc Disease
Anterior Lumbar Interbody Fusion
ALIF
MIS Advantages
Clinical

- Less Blood Loss
- Less Transfusions
- Less Pain Med Requirements
- **Less Muscle Dissection**
- Clinical Benefits 1-2 years
- Similar Long Term Benefits
- LESS PHYSICIAN WEAR AND TEAR

*Figure 1. Photograph demonstrating traditional open posterior wound for segmental fixation.*
SUMMARY
ACUTE Back Pain
RED FLAGS AND WHEN TO REFER

• Cauda Equina Syndrome: saddle paresthesias, bowel/bladder,
• Cervical Myelopathy: hyper-reflexia, upper motor signs,
• Energy of Injury: fractures
• Motor Weakness and Progression
• Radicular Pain-”relative”-sooner than axial back pain
• Beware of concomitant medical issues
• Failure to respond to non-operative treatment
• When in doubt—”NOT A SIGN OF WEAKNESS”
THANK YOU