Degenerative Lumbar Spine Disease

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Core Radiology Clerkship
BIDMC PCE
Overview

- Patient Presentation: Ms. S
- Clinical Work-up of Low Back Pain
- Menu of Radiological Tests
- Lumbar Spine Anatomy
- Patient Imaging: Ms. S
- Discussion of Degenerative Spine Disease
Our Patient, Ms. S

- 88 year old woman with chronic low back pain
- 4 year history of back pain
  - Radiation: left hip, thigh, calf, ankle
  - L5 dermatome distribution
- The pain is inconstant
  - Relief with sitting
- Ms. S is normally an active woman
  - Controls pain with Celebrex and epidural steroid injections
- Presents to the pain clinic after 3 epidural steroid injections failed to provide relief
Clinical DDx Low Back Pain

Musculoskeletal
- Bone
  - Fracture, spondylosis, spondylolisthesis
- Joints
  - Facet joint degeneration
- Disks
  - Herniation, annular tears
- Ligaments
  - Ligament hypertrophy or ossification
- Muscles
  - Strain

Systemic Disease
- Infection
  - Osteomyelitis, spondylodiscitis, epidural abscess
- Inflammatory Arthritis
  - RA, AS, Psoriasis
- Neoplastic
  - Primary tumors, metastatic cancer, lymphoma, multiple myeloma
- Visceral Condition
  - CV: Aortic aneurysm
  - GU: stones, infection
  - GI: pancreatitis, ulcers
  - Gyn: Endometriosis, PID

Low Back Pain

- A challenging issue in outpatient medicine
- Point prevalence as high as 33%
- Lifetime prevalence as high as 80%
- Fifth most common reason for physician visits in US
- 1 in 5 patients report substantial limitations in activity due to LBP

Low Back Pain Work-Up

- Imaging can create more questions than answers
- Especially in the elderly, degenerative spinal is incredibly common in asymptomatic subjects
  - Disk herniation: 25-50%
  - Disk degeneration: 25-70%
  - Annular tears: 14-33%
- Most LBP resolves spontaneously, as do many radiographic findings

However, it is important to be aware of red flags which necessitate imaging …
Red Flags with LBP

**Fracture**
- Age >70
- History of osteoporosis
- Trauma
- Corticosteroid use

**Tumor**
- Age >50
- History of previous cancer
- Unexplained weight loss

**Infection**
- Fever, chills
- Recent skin or urinary infection
- Immunosuppression
- IVDU
- Recent spine surgery

**Neurologic**
- Sciatica
- New onset urinary/fecal incontinence
- Abnormal neurologic exam: motor, sensory, reflexes

Menu of Tests for Low Back Pain Assessment

- More Commonly Used:
  - Plain Films
  - CT and CT Myelography
  - MRI
  - Bone Scintigraphy - assessing for metastatic cancer

- Less Commonly Used:
  - Plain Myelography - supplanted by CT myelography
  - Discography - contrast injection into disk to assess for disk source of pain
  - Spinal Angiogram - assess vasculature of spine
L-Spine Plain Films

Pros:
- Fast, no contraindications
- Good for evaluating bony structures
  - Trauma
  - Bony degeneration
  - Spine alignment

Cons:
- Poor soft tissue discrimination
- Frequently will need CT/MRI anyway
- Radiation exposure

Image courtesy Dr. Kleefield, BIDMC
CT and CT Myelography

- **Pros:**
  - Excellent resolution of bony anatomy
    - Trauma eval
    - Degenerative bony changes
    - Good for visualizing calcifications and gas
  - Myelography: useful for LBP eval when MRI is contraindicated

- **Cons:**
  - Poor differentiation of soft tissues within the spine
  - Radiation exposure
  - Myelography: invasive procedure
Magnetic Resonance Imaging (MRI)

- **Pros:**
  - Excellent soft tissue discrimination
  - No radiation exposure
  - Most sensitive modality for evaluating the spine

- **Cons:**
  - Less sensitive for evaluating bony anatomy and calcifications
  - Contraindicated for patients with metal devices, etc.
  - Expensive
Simplified LBP Diagnostic Algorithm

Red Flags?

- NO

Conservative management, re-evaluate in 4 weeks

Subacute neurologic symptoms? (i.e. sciatica)

- NO

Re-eval in 4-6 weeks

Concerned about tumor, infection, or acute neurologic deficits?

- YES

MRI

OR

Trauma

MRI

No further evaluation

Improvement?

- YES

MRI

- NO

MRI and/or Plain Films

Lumbar Spine: Sagittal Anatomy

Ligamentum flavum
Note thickness

Vertebral disk
Note central high T2 signal (NP) and low peripheral signal (AF)

Spinal canal
Note the width and amount of CSF

Normal Lumbar Spine MRI Sagittal T2

MRI Image from PACS, BIDMC
Lumbar Spine: Bone and Joint Anatomy

Lumbar Spine: Axial Anatomy

- **Ligamentum flavum** - Note the thickness here
- **Facet joint** - Note how the joint surfaces align and the thin layer of high signal fluid between layers of low signal cartilage
- **Vertebral disk** - Note the clean, concave margin of the annulus fibrosus (AF) next to the dura of the spinal canal. Nucleus pulposus = NP.
- **Neural foramina** - This is an important area because the nerve roots exit here; note the space between the vertebral body (VB) and the facet joints here.
Due to her neurologic symptoms and lack of response to pain control Ms. S had an MRI of her lumbar spine ...
Ms. S: Extradural Masses and Spinal Stenosis on MRI

Findings
- **Spinal canal** stenosis from L2-L5 due to extradural masses
- **Protruding** low signal masses in posterior spinal canal L2-L5
- **Disks** - Low signal intensity from L2-L5 in addition to extension of disk into the spinal canal
- **Vertebrae** - Posterior displacement of the L4 vertebrae

Images from PACS, BIDMC
Differential Diagnosis: Extradural Mass

- **Degenerative**
  - Disk herniation
  - Spinal stenosis
  - Ligament ossification
  - Synovial cyst

- **Neoplastic**
  - Primary vertebral tumor
  - Others: meningioma, neurogenic tumor
  - Lymphoma
  - Metastasis

- **Infection**
  - Osteomyelitis
  - Epidural abscess

- **Trauma**
  - Epidural scar
  - Iatrogenic
  - Hematoma
  - Fracture fragment

- **Others**
  - Lipomatosis
  - Paget’s disease
  - Extramedullary hematopoiesis
  - Amyloidosis
  - Granulomatous diseases


Image from PACS, BIDMC
Ms. S: Facet Arthropathy on MRI

Low signal mass in posterior spinal column

Spinal canal - marked reduction of CSF signal and compression of canal

Facet joint arthropathy - osteophyte formation and distortion of joint alignment
Ms. S: Disk Bulge on MRI

Disk - Bulging of disk beyond margin of L4 vertebrae
Facet joint arthropathy - osteophyte formation and distortion of joint alignment
Ms. S’s Diagnosis: Degenerative Spinal Stenosis

- **Most likely:** degenerative spinal stenosis
  - Broad radiological differential
    - However, characteristic set of findings present
      - Osteophytes + misalignment: facet joint arthropathy
      - Low signal posterior masses: ligamentum flavum hypertrophy
      - Disc extension into canal: disc bulge
      - Posterior vertebrae displacement: spondylolisthesis
  - Narrowed by history
    - Chronic nature of pain
    - Relief with sitting (neurogenic claudication)
    - Advanced age
    - No other red flags: no evidence of infection, tumor, trauma
  - Neurological signs possibly consistent with stenosis present at L4-L5, but most severe stenosis is L3-L4
Let’s discuss in more detail the degenerative spine disease found in Ms. S’s imaging.
Facet joint arthropathy and ligamentum flavum hypertrophy

- Degenerative change in facet joints can be due to:
  - Osteoarthritis
  - Disk degeneration
- Ligamentum flavum hypertrophy
  - Due to vertebral instability
- Joint changes only present in a few percent of asymptomatic patients

Katz JN and Harris, MB. Lumbar Spinal Stenosis, NEJM 2008 358:818-25
Companion Patient #1: Facet joint arthropathy

**Hypertrophic bone formation (CT>MRI)**

**Joint space narrowing**

**Associated:** ligamentum flavum hypertrophy

**Not seen here:** subchondral sclerosis (CT>MRI)

Image courtesy Dr. Kleefield, BIDMC
Disk Herniation

- Many asymptomatic individuals have evidence of disk herniation
- Often spontaneously regresses
- If herniation is symptomatic, results in symptoms in nerve root inferior to level of herniation
  - i.e L3-L4 herniation --> L4 radiculopathy
- Different types of herniation
  - Disk Bulge (technically not herniation), Protrusion and Extrusion
Ms. S: Disk Bulge

Circumferential increase in diameter without annulus rupture
(not a true herniation)
Companion Patient #2: Disk Protrusion

Focal bulge without complete annulus rupture

Axial T2 MRI

Image courtesy Dr. Kleefield, BIDMC
Companion Patient #3: Disk Extrusion

Nucleus pulposus ruptures through annulus fibrosus and extends into epidural space

Image courtesy Dr. Kleefield, BIDMC
Spondylolisthesis

- Spondylolisthesis = slippage of vertebrae anteriorly or posteriorly
  - Can be caused by congenital factors, degenerative disease, trauma, or systemic disease
  - Severe displacement result in radiculopathy by compression or stretch
  - Also contributes to spinal canal stenosis
Companion Patient #4: Spondylolisthesis

Two examples of posterior spondylolisthesis

Images courtesy Dr. Kleefield, BIDMC and PACS, BIDMC
Conclusions

- Ms. S’s continued symptoms are consistent with an L5 radiculopathy
- However, her imaging is not consistent with this
  - She has more severe degeneration elsewhere
- What can be done?
  - Surgery can be considered
  - Continued pain management
  - Alternative therapies: acupuncture, exercise
- Sometimes imaging can confuse the clinical picture, especially with low back pain
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References

(2) Katz JN and Harris, MB. Lumbar Spinal Stenosis, NEJM 2008 358:818-25.