Infectious Spondylodiscitis

Sebastián Bravo Grau
(University los Andes - Faculty of Medicine 7th year)
Dr. Felipe Aliaga
Dr. Gillian Lieberman
Agenda

• Patient Presentation
• Normal Anatomy
• General information
• Imaging of Spondylodiscitis
  • Plain films
  • CT
  • MRI
  • Bone scan
• Take Home Points
Our Patient: PMH

• In Santiago, Chile.
• Women - 67 years.
• PMH:
  • Cirrhosis. Child-Turcotte-Pugh class B.
  • Secondary portal hypertension.
  • Gastroesophageal varices.
• Diabetes Mellitus Type 2
• Hypertension. Hypertensive cardiopathy.
Our Patient: PMH

• Admitted on June 2009 for UGB
  • Gastric ulcer - Forrest IIC - treated.

• During this period the patient referred:
  • 1 month history of upper back pain.
  • New onset band-like radiation of pain to right side.

• Afebrile, normal WBC count.
Our Patient: Thorax CT. Fracture of T4 vertebral body with abnormal soft tissue surrounding

Cortical breakthrough, bilaterally.

Abnormal soft tissue surrounding the vertebral body.

Thorax CT: axial view without contrast

Image From Hospital Militar de Santiago, Chile.
Our Patient Presentation

• To further assess intrathecal pathology, MRI was indicated by the medical team.
• In spite of this, the patient and her family, request discharge.
• At this point, the patient was afebrile, neurological exam was normal, as WBC count.
Our Patient Presentation

• … 6 days later
Our Patient: HPI

- HPI:
  - History of 48 hours with progressive paraparesia and sphincter relaxation.
- Afebrile.
- Lab:
  - WBC: 27,400
  - ESR: 86
  - Blood cultures: Gram-positive cocci clusters.
  - *St. Aureus*
Our Patient: MRI. Collapse of T4

Collapse of T4 vertebral body. (inside the box)

T2-weighted image in sagittal plane

Image From Hospital Militar de Santiago, Chile.
Our Patient: MRI. Spondylodiscitis

- **Collapse of T4 vertebral body.**
- **Increased signal intensity in the T3-T4 disk.**
- **Abnormal signal in epidural space.**
- **Abnormal soft tissue, anterior to the vertebral body.**

Image From Hospital Militar de Santiago, Chile.
Our Patient: MRI. Spinal canal stenosis

T2-weighted image in sagittal plane

Posterior convex border. Retropulsion causing severe spinal canal stenosis and cord compression.

Image From Hospital Militar de Santiago, Chile.
Decreased signal intensity of bone marrow in T4 and T5.
Our Patient MRI: Spondylodiscitis

T1-w sagittal plane contrast-enhanced

Image From Hospital Militar de Santiago, Chile.
Our Patient MRI: Spondylodiscitis. Abnormal soft tissue enhancement

Severe compression of T4 with abnormal enhancement

Soft tissue enhancement

Abnormal enhancement within the T5 vertebral body. (*)

T1-w sagittal plane contrast-enhanced

Image From Hospital Militar de Santiago, Chile.
Our Patient: MRI. Spondylodiscitis with large paraspinal collection

MRI. T2-weighted. Axial and Coronal

Both Images From Hospital Militar de Santiago, Chile.
Agenda

• Patient Presentation
• Normal Anatomy
• General information
• Imaging of Spondylodiscitis
  • Plain films
  • CT
  • MRI
  • Bone scan
• Take Home Points

Background image from: http://www.flickr.com/photos/deepblue66/369213890/
Thoracic Spine: Normal Anatomy on MRI

- Spinal cord
- Vertebral body
- Intervertebral disc
- Anterior cortical margin
- Ligamentum flavum
- Spinous process
- Superior and inferior endplate

Sagittal T1-weighted MRI.

Image from PACS, BIDMC, Boston, MA.
Diagrams of Normal Anatomy

Diagram from:  http://www.spineuniverse.com/displayarticle.php/article1267.html

Diagram from:  http://www.spineuniverse.com/displayarticle.php/article1394.html
Infectious Spondylodiscitis: General Information

- Infectious spondylitis accounts for 2%-4% of cases of skeletal infection.
- The most common infecting organism is *Staphylococcus aureus*. (55%-90%)
- Other causes of pyogenic infections of the spine:
  - *Streptococcus, Pneumococcus, Enterococcus, E. Coli, Salmonella, Pseudomonas aeruginosa* and *Klebsiella*.
- Non-pyogenic (granulomatous) infections originate from:
  - *Mycobacterium tuberculosis, Brucella*, fungi and parasites.
Infectious Spondylodiscitis: General Information

• Note:
  • This presentation is mainly related to pyogenic infectious spondylodiscitis.
Infectious Spondylodiscitis
Epidemiology

- Incidence has steadily risen in recent years because of:
  - Increases in spine surgery
  - Increases in nosocomial bacteremia
  - Aging of population
  - Intravenous drug addiction
Infectious Spondylodiscitis: Clinical Manifestations

- Patients with a spinal infection most often present with axial back pain.
- Other constitutional symptoms may be present.
- Neurologic compromise not usually part of the early manifestations.
- Laboratory results are often, but not always, abnormal.
  - Leukocytosis often present, but not always.
  - ESR and CRP are usually, but not always, elevated.
Pathophysiology of Spinal **Bacterial** Infection

- Direct inoculation
  - Penetrating trauma
  - Spinal procedures (percutaneous or open)

- Contiguous spread from an adjacent infection
  - Local spread following intra-abdominal or retro-peritoneal infections.

- **Hematogenous**
  - From distant septic foci. Skin and soft tissue infections, infected vascular access sites, UTI.

Pathophysiology:
Hematogenous Dissemination

- **Venous Theory**
  - Batson demonstrated retrograde flow from the pelvic venous plexus to the perivertebral venous plexus via valveless meningorrhachidian veins.

- **Arteriolar Theory**
  - Wiley and Trueta: bacteria can become lodged in the end-arteriolar network near the vertebral plate.
Pathophysiology: 
Contiguous Spread

- Infection established adjacent to the end plate of one vertebral body.
- Can rupture through it into the adjoining disk and infect the next vertebral body.
- The disk material is relatively avascular and is rapidly destroyed by the bacterial enzymes.
- Cervical spine: if infection penetrates the prevertebral fascia, it can extend into the mediastinum.

Pathophysiology:
Contiguous Spread

• Lumbar spine: abscess formation may track along the psoas muscle and into piriformis fossa, perianal region and the groin.
• Extension into the spinal canal, may result in: epidural abscess or even bacterial meningitis.
• Destruction of the vertebral body and intervertebral disk can potentially lead to instability and collapse. (as in our patient)
• Infected bone or granulation tissue may be retropulsed into the spinal canal, causing neural compression or vascular occlusion.

Classification of Spinal Infections: Duration of Symptoms

<table>
<thead>
<tr>
<th>Acute</th>
<th>Subacute</th>
<th>Chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3 weeks</td>
<td>3 weeks - 3 months</td>
<td>&gt;3 months</td>
</tr>
</tbody>
</table>
• Spinal infections can be devastating and can result in significant pain, deformity, and neurologic deterioration (as in our patient).

• The accurate diagnosis and appropriate treatment of spinal infections is important.
Menu of Tests Used to Diagnose Infectious Spondylodiscitis

- Plain Film
- CT
- Radionuclide Bone Scan
- MRI
Plain Radiographs

• Should be taken on all patients with or suspected of having a spinal infection.
• Changes appear at least 3 to 4 weeks after onset of the disease.
• Sensitivity: poor in early acute osteomyelitis.
Plain Radiographs

- Findings:
  - Soft tissue swelling around the area of infection.
  - Loss of disc height.
  - Endplate sclerosis, from reactive bone formation.
  - Cortical resorption: osteopenia, scalloping of endplates, subperiosteal defects.
Companion Patient 1: Lateral C-Spine

- Spinal infection.
- Early radiographic abnormalities.
- Lateral radiograph of the cervical spine.
- Destructive lesion within the anterior subchondral region of C5 and C4.
- Initial narrowing of C4-C5 disc.

Companion Patient 2: Lateral L-Spine

- Vertebral infection.
- Advanced radiographic changes.
- Lateral radiograph of the lumbar spine.
- Destruction of vertebral bodies with narrowing of the L3-L4 disc space.

Spiral CT with IV contrast

- Excellent detail of bony anatomy, including any sequestra or involucra.
- Identify the presence of adjacent soft tissue masses or abscesses.
- Disk space narrowing or decreased attenuation in the disk.
- With contrast: abnormal disk space, vertebral marrow or paravertebral soft tissues may enhance.
- Destruction of vertebral body and fragmentation of vertebral endplates.
Spiral CT with IV contrast

- Inferior to MRI in evaluating disc spaces and the neural elements.
- The size of the infected granulation tissues or abscesses can be monitored but the inflammatory reaction in the bone marrow is not well depicted.
- CT myelograms is not the preferred imaging technique in pyogenic infections.
- Potential for intradural spread of the infection.
Companion Patient 3: Infectious Spondylodiscitis on CT

Disc space narrowing with erosion of the adjacent vertebral body endplates.

CT. Coronal reconstruction

Images From: [http://www.statdx.com](http://www.statdx.com) Case Contributor: Jud W. Gurney, MD, FACR
Companion Patient 3: Infectious Spondylodiscitis on CT

Paraspinal widening.

Images From: [http://www.statdx.com](http://www.statdx.com) Case Contributor: Jud W. Gurney, MD, FACP
• Let's remember our patient ...
Our Patient: Thorax CT. Fracture of T4 vertebral body with abnormal soft tissue surrounding

Cortical breakthrough, bilaterally.

Abnormal soft tissue surrounding the vertebral body.

Thorax CT: axial view without contrast

Image From Hospital Militar de Santiago, Chile.
Radionuclide Bone Scan

- Can be much more sensitive than radiographs in detecting early disease.

- Menu of Bone Scan:
  - Three-phase technetium-99m bone scan
  - Gallium-67 citrate scan
  - Combination of technetium and gallium
  - Indium 111-labeled leukocyte scintigraphy
Radionuclide Bone Scan: Technetium 99m Three-phase Bone Scintigraphy

- Technetium 99m Three-phase Bone Scintigraphy:
  - Flow phase.
  - Blood pooling phase.
  - Delayed phase.
- Osteomyelitis causes focally increased uptake in all three phases.
Three-phase technetium-99m bone scan

- Sensitive (90%) but nonspecific (78%) for spinal infections.
- Particularly in older patients with some degree of spondylosis and degenerative disc disease.
- Provide little anatomic detail.
- Can be positive in the setting of osteoporotic fractures and neoplasms.
Gallium-67 citrate scan

- Gallium-67 citrate scans have similar sensitivity (89%) and specificity (85%) and accuracy (86%) as technetium scans in evaluating pyogenic spinal infections.

- Combination of these studies (gallium and technetium scans) can be more helpful in making diagnosis.
  - Accuracy of 94%.

Indium 111-labeled leukocyte scintigraphy

- Specificity is improved.
- Sensitivity is very low (17%).
- May be helpful only in selected patients.
- Should not be used routinely. (because high rate of false-negative results)


- Posterior labeled leukocyte scintigraphy shows photopenia in known spinal osteomyelitis.

- Labeled leukocyte scan is often falsely negative in spinal osteomyelitis.

Image From: http://www.statdx.com

- Posterior bone scan shows increased activity in endplates of two adjacent vertebral bodies.
- Characteristic of discitis or discogenic sclerosis.

Image From: http://www.statdx.com
MRI

- Magnetic resonance imaging is a powerful diagnostic tool that can be used to help evaluate spinal infection and to help distinguish between an infection and other clinical conditions.
- Gold standard for imaging of spinal infections.
- Especially useful in the early stages when other imaging modalities are still normal or nonspecific.
- Sensitivity (96%) and specificity (92%).

MRI

• Usual findings:
  • Vertebral endplate destruction
  • Bone marrow and disk signal abnormalities
  • Paravertebral or epidural abscesses.
• Typical signal pattern of acute spinal infection:
  • Increase in fluid signal because of marrow edema
  • Signal decrease in T1-weighted sequences
  • Signal increase in T2-weighted sequences.

MRI

• Not always easy:
• Classic MRI features are absent
• Unusual patterns of infectious spondylitis
• Noninfectious inflammatory diseases and degenerative disease may simulate spinal infection.

Companion Patient 6. MRI: diskitis/osteomyelitis

- Destruction of L3-4 disk space with the adjacent endplate and vertebral body.
- L3 and L4 vertebral bodies show increased T2 signal.
- Retropulsion of debris, with secondary compression.

Image From: E-Medicine:

MRI. T2-w of lumbar spine. Sagittal view.
Our Patient MRI: Spondylodiscitis

Severe compression of T4 with abnormal enhancement

Abnormal enhancement within the T5 vertebral body

Soft tissue enhancement

T1-w sagittal plane contrast-enhanced
Some Differential Diagnosis

This is NOT an infectious spondylodiscitis

BIDMC PACS. 84 yo man. MRI. T1 seq. Sag. Acute moderate T6 compression fracture.
# Osteomyelitis vs Tumor

<table>
<thead>
<tr>
<th></th>
<th>Osteomyelitis</th>
<th>Tumor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contiguity</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Paraspinal soft tissue mass</td>
<td>Yes (abscess)</td>
<td>Less common</td>
</tr>
<tr>
<td>Disk space</td>
<td>Isocenter</td>
<td>Not involved</td>
</tr>
</tbody>
</table>

Take Home Points

- Changes on plain radiographs occur at late disease.
- MRI is the gold standard for imaging of spinal infection.
- Soft tissue helps to narrow the differential diagnosis.
- This is a patient where the imaging findings superseed the clinical findings.
References (1 of 2)

References (2 of 2)

- StatDx – http://www.statdx.com
- Emedicine – http://emedicine.medscape.com
Acknowledgements

• Dr. Rivka Colen
• Dr. Dan Anghelescu
• Nicolas Ahumada

Background image from: http://www.flickr.com/photos/m750/50103339/
Thank You