Radiologic Diagnosis of Spinal Metastases

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Our Patient’s Presenting Story

- 70 year old male
- Presents to the hospital for laparoscopic cholecystectomy
- Receives pre-operative chest x-ray
Pre-operative Chest X-Ray: PA view

Findings:
- Abnormal lobulated pleural thickening
- Material of density greater than cortical bone
- Decreased volume of right lung field
Pre-operative Chest X-Ray: lateral view

Findings:
- Major fissure
- Right middle lobe opacity
- Objects of density greater than cortical bone
- Loculations

From BIDMC PACS
What’s going on here?!!
The Importance of Obtaining a Full Patient History

- Past history of **renal cell carcinoma** with resection in 1999 (hence sutures)
- Past history of **non-small cell lung carcinoma** with resection of right middle lobe 7/02 (hence more sutures and decreased right lung volume)
- Current complaints of **low back pain, urinary retention, and paresthesias** in right lower extremity…
Differential Diagnosis

- Knowing that our patient has a history of two types of cancer that frequently metastasize
- Knowing of his symptoms of back pain and parasthesias

Metastatic Disease of the Spine must be at the top of our list.
Differential Diagnosis for Chest X-Ray Findings

- **Multiple myeloma**-”punched out” lytic lesions
- **Paget’s**-large, sclerotic bones; coarse trabeculae
- Infection
- Infarction
- Trauma
- Primary bone tumor

Common Bone Metastases—Radiographic Appearance

Lytic Lesions:
- Breast
- Lungs
- Kidney
- Thyroid

Sclerotic Lesions:
- Breast
- Prostate

Example of Sclerotic Lesions—Comparison Patient I

Patient diagnosed with prostate cancer

- Sclerotic bone lesions

Courtesy of Ferris Hall, MD
Common Sites of Bone Metastasis

- Spine
- Pelvis
- Ribs
- Skull
- Proximal humerus or femur

Classical Presentation of Metastatic Bone Disease

- History of new onset bone pain (present in our patient)
- Pathologic fracture (no current indication of this)

How to Work Up Possible Spinal Metastases

- If no symptoms, first do a bone scan.
- If positive scan, perform focused radiography.
- If symptoms, evaluate sites of pain by radiography.
- If radiograph is negative or equivocal, perform bone scan.

How to Work Up Possible Spinal Metastases (cont’d)

- If radiograph and bone scan disagree, remember that bone scan is more sensitive. Use CT or MRI as follow-up study.

Skeletal Scintigraphy

- Nuclide usually polyphosphates labeled with technetium-99
- IV injection
- Visualization after 2 hours
- Increased uptake in areas of increased bone turnover: tumor, infection, fracture, arthritis, periostitis

Bone Scan of Spinal Metastases-Comparison Patient II

Patient with renal cell carcinoma metastatic disease

Lesions with increased uptake

Enlarged soft tissue due to lymphedema

Courtesy of K.P. Donohoe, MD.
Bone Scan of Spinal Metastases - Comparison Patient III

Patient with colon cancer

Areas of increased radionuclide uptake likely to be metastatic disease

Area of increased uptake likely to be degenerative joint disease

Courtesy of K.P. Donohoe, MD
Findings on Abdominal X-Ray- Comparison Patient III

PA view:

- “Pedicle sign”– destruction of cortical outline of pedicle
- Malalignment
- Increased radiolucency or radiopacity
Findings on Chest X-Ray—Comparison Patient III (cont’d)

Lateral view:
- Compression fractures/vertebral body collapse
- Changes in bone density
- Cortical destruction
- Nearby soft tissue mass
After Radiography

Although our patient did not exhibit classical signs of spinal metastases on plain radiographic studies, his history indicates a high suspicion for metastatic disease.

What comes next?
CT vs. MR

**Advantages of CT**
- Better visualization of cortical destruction
- Good visualization of replacement of fatty marrow with soft tissue density of metastasis

**Advantages of MR**
- Visualizes the relationship between the vertebra and spinal cord (neurological symptoms)
- No need to inject contrast to view vascular structures

Axial Spinal Anatomy

Vertebral Body
Spinal Cord
Rib
Paraspinal Musculature
Lungs
Sternum

From Digital Anatomist: http://www9.biostr.washington.edu/cgi-bin/DA/imageform
Anatomy (cont’d)– Vertebral Detail

- Pedicle
- Neural Foramen
- Spinous Process
- Spinal Cord
- CSF Space
- Exiting vertebral nerve

From Digital Anatomist:  http://www9.biostr.washington.edu/cgi-bin/DA/imageform
Our Patient’s CT Scan

Findings with Lung Window Settings:

Loculated Pleural Effusion (13 HU indicating fluid); probably resulting from resection of RML
Our Patient’s CT Scan (cont’d)

Findings with CT Bone Window:

- Loss of cortical margin
- Change in density within vertebral body

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Characteristics of MR Studies

- **T1-weighted images** are best for determining extent of marrow involvement.
- **T2-weighted images** are best for examining cortical bone destruction and soft-tissue extension.
- **T2 with fat suppression**: signal from fat is suppressed allowing for better contrast between normal and diseased bone marrow and better visualization of free water/edema.

Our Patient’s MR Study

Findings on T1-weighted Image (sagittal view):

- **CSF**– low-signal intensity
- Low-signal intensity lesions in vertebral bodies (Normal marrow should approach the brightness of subcutaneous fat.)
Our Patient’s MR Study (cont’d)

More Findings on T1-Weighted Imaging (Axial View):

- Low-signal intensity lesion in vertebral body
- Involvement of right pedicle
- No apparent impingement of spinal cord
Findings on T1-Weighted Image (sagittal view):

- CSF– low-intensity signal
- Low-signal intensity lesions in vertebral bodies
- Bright subcutaneous fat
Findings on T2-Weighted Image:

- CSF—high-signal intensity
- Lesions within vertebral body
- Obliteration of neural foramen (compare with other side)
Findings on T2-weighted image with fat suppression:

- Degenerative change
- Unsuppressed marrow lesions (Signal from normal marrow should be suppressed with fat.)
Our Patient’s MR Study (cont’d)

Findings on T2-weighted image with fat suppression:

- Unsuppressed marrow lesions (indicating the presence of edema)
- Compression fracture

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So what do we do now that we know that it’s metastatic disease?
Reasons for Performing CT-guided Bone Biopsy

- Distinguish between metastatic disease and infection
- To make a pathological diagnosis in order to determine further treatment (especially in our case with two primary malignancies)

Approach for CT-Guided Bone Biopsy
Pathology Results:
Atypical squamous cells consistent with non-small cell lung cancer.

Types of Non-Small Cell Lung Cancer
Treatment Options/Prognosis

Because our patient has widespread metastatic disease, his most likely treatment option is radiation therapy. This therapy is only palliative. It is likely to reduce his pain and may decrease any compression on his spinal cord, possibly ameliorating his neurological symptoms.

However, his five-year survival probability is very low.

Summary of Course of Action for Metastases

1. Bone Scan/Plain Film Radiography depending on whether or not the patient is symptomatic
2. CT and/or MRI
3. Bone Biopsy for Pathological Diagnosis, if necessary
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References


Digital Anatomist: http://www9.biostr.washington.edu/cgi-bin/DA/imageform
