MRI of Musculoskeletal Infection and Mimickers

CASE 1:
10 year old female with ankle pain for 3 weeks
Could this be a tumor?
What is the significance of metaphyseal location?

**Brodie’s Abscess**
- Metaphyseal
- Distal tibia most common
- ‘Drips’ to physis

**Chronic Recurrent Multifocal Osteomyelitis (CRMO)**
Simulates Brodie’s abscess – but multifocal, recurring

**CRMO**
Relapsing infection
Possibly viral
Immunosuppression likely
Acute on Chronic Osteomyelitis

Pediatric

Pre-Gd

Involucrum

Post-Gd

Gd

Acute on Chronic Osteomyelitis

Pediatric

Pre-Gd

Involucrum

Post-Gd

Gd

CASE 2

21 year old female with left lower back pain, and progressive, severe sciatic pain

What is it??

CASE 2

Answer: Septic sacroiliitis

Why is SI joint septic arthritis so hard to diagnose? What does it mimic?

CASE 2

learning point:

Large effusion in small joints

Rapid onset of effusion ruptures capsule – edema spreads through surrounding tissues

Septic Arthritis

DDx Reactive synovitis

Dx of nontraumatic effusion in ped: must consider infection

- Spring / summer in northeast US: Lyme disease

T1

STIR
Septic Sacroiliitis
Soft Tissue Extension & Abscess

Abscess:
- Focal fluid signal
- Rim enhancement

Same Process in Other Joints
Sternoclavicular
Acromioclavicular
Small joints of the fingers, toes

Septic Arthritis:
- Finger
  - Erosion
  - Thick rim enhancement
  - Subchondral edema

DDx: Inflammatory arthropathy

Septic Arthritis - Later
- Perivascular and subchondral edema due to hyperemia

Septic Arthritis
progression to osteomyelitis
- Note extension beyond perivascular, subchondral bone
**Pitfalls: Non-Infectious Inflammatory Arthritis**

- **Rheumatoid Arthritis**

**Rheumatoid Arthritis**

**Synovitis** – “dirty fluid” on T2

**Reactive Arthritis** (Reiter’s Disease)

**Ankylosing Spondylitis**

**Psoriatic Arthritis**

**NOTE:** no periarticular edema

**Early**

- Loss of subchondral white line

**Late**

- Sclerosis, fusion

**Asymmetric involvement**
CASE 3
18 year old male with increasing upper arm pain for a month
Is this tumor or infection?
What lesson does this teach with reference to biopsy?

Case 3:
If tumor, what histology would be suggested?

Hematogenous Osteomyelitis
Presenting as a small round cell lesion

Tumor Margin Types
Lodwick Classification

Permeative / Motheaten
IF IT LOOKS LIKE INFECTION:
Always consider tumor

IF IT LOOKS LIKE TUMOR
Always consider infection

IF YOU CAN’T BE SURE
Send samples to path and micro

Tumors Can Simulate Infection
– Ewing Sarcoma
– Primary Lymphoma

Unni KK. Dahlin’s Bone Tumors, General Aspects and Data on 11,087 cases.

Myeloma
Permeative
Motheaten
Geographic
Lodwick Classification

Courtesy Laura Bancroft, MD
Infection or Tumor?

Lymphoma

Chronic Osteomyelitis Simulating Lymphoma

CASE 4
25 year old male with chronic back pain, deformity
What is the likely etiology?
What are differences between bacterial discitis and atypical infection?

Mycobacterial Infection

- Increasing prevalence
  - Immunocompromised patients
  - Atypical species
  - Drug resistant strains
- Skeletal M. tuberculosis: 3-5% of cases
  - Spine most common site (25-60%)
  - Spine: T/L junction most common
  - Most have infection elsewhere also (pulmonary / GU)
**Tuberculosis - Clinical**

- Insidious onset
  - Back pain / stiffness, focal tenderness
  - Fever, malaise, weight loss
  - Cough, hemoptysis, UTI
  - Neurologic impairment

**Tuberculosis - Imaging**

- Classically, preservation of disc height until late
- Paraspinal soft tissue disease - can spread to multiple levels along ligaments
- Late - endplate destruction, sclerosis
- Chronic disease - soft tissue Ca++
- Deformity: kyphosis ('gibbus'), fusion

**TB Spondylitis**

- Mass-like destruction

**Fungal / Parasitic**

- Uncommon
- Brucellosis, Coccidioidomycosis, Candida, Aspergillus, Echinococcus
- Prior exposure (travel, animals)
- Atypical imaging presentation
  - Solitary or multiple masses - ‘Tumor pattern’
  - indolent disc infection - ‘Degenerative pattern’

**Tumor-like Presentation**

- Coccidioidomycosis

Paraspinal spread to multiple levels
Deformity
CASE 5
57 year old male with rapid onset back pain
Is this definitely infection? What are mimickers of discitis?

CASE 5
Is this definitely infection? What are mimickers of discitis?

Discitis
Hematogenous Spread
- Infection usually begins near endplate
- Adjacent disc avascular
  - Exceptions
    - infants -> adolescents - penetrating vessels
    - degen disc disease - revascularization of disc
- Disc not thought to be a common site of implantation

Arterial spread

Early infection at the periphery of the endplate
Neuropathic disease / Segmental instability

- Excess motion +/- decreased sensation
- Appearance similar to infection:
  - disc narrowing
  - endplate irregularity / destruction / sclerosis
- MRI
  - low T1, high T2, +Gd enh in disc / endplates
  - paraspinal edema / mass effect, fluid collections

Post-op T-spine fusion

Follow-up – NP disease

Uh oh! I should have refused this one!
Neuropathic Disease / Instability

- Bone production
- Destruction
- Disorganization/debris

Laminectomy: source of instability

Neuropathic disease / instability

T1 Gd STIR

Listhesis

Facet joint involvement

Amyloid / Dialysis-associated Spondyloarthropathy

- Differences from infection
  - skeletal manifestations of CRF / secondary HPT, clinical history
    - "rugger jersey" spine
    - SI resorption, distal clavicular resorption
    - subperiosteal resorption
    - acro-osteolysis
  - MRI: amyloid low T1 / T2
- May require biopsy (Congo red stain)

Amyloid of the Spine

Destruction

Erosion

CASE 6

60 year old bedridden patient with a calcaneal ulcer
Should this be called osteomyelitis?
What is "osteitis"?

Amyloid of the Spine

T1 T2

low low
“Osteitis” vs Osteomyelitis

Fat signal preserved on T1
Some? All?

Early Osteomyelitis

Fat signal on T1 may be preserved early on

3 weeks later

4 more days

CASE 7
45 year old diabetic patient
Is this neuropathic disease?
Infection?
Both?

Neuropathic Osteoarthropathy

Radiographic:
- Dislocation
- Disorganization
- Debris
- Destruction
- Density of bone preserved
Neuropathic Osteoarthropathy

**Acute vs. Chronic**
- Acute - hot, swollen erythematous foot; clinically simulates osteomyelitis
- Chronic - Clinical request usually to exclude superimposed osteomyelitis

**Neuropathic Osteoarthropathy**

**Acute Form**
- Not much deformity
- Effusions
- Multiple joints
- Marrow edema
- Periarticular enhancement

**Chronic Form**
- Disorganization
- Subluxation
- Cuboid weight-bearing
- Callus, ulcer
- Normal marrow signal

**Neuropathic Osteoarthropathy**

**Differential Features - NP vs Osteo**

**Rules of Thumb**
- NP disease has **articular epicenter**
  - NP: Usu multiple joints involved: regional instability pattern
  - Osteomyelitis: marrow epicenter: centripetal spread
  - NP osteoarthropathy is an aggressive form of degeneration: subchondral cysts common

**Osteomyelitis of the Foot**
- > 90% transcutaneous spread
  - If adjacent SQ fat is preserved, prob not osteo
  - Bone erosion; cysts uncommon

**Distribution**
- Osteomyelitis more common in *phalanges*, *MTs, calcaneus* (secondary to overlying ulceration on the plantar surface)
- NP more common in *Lisfranc joint, Chopart joint, ankle joint*
- Exception: atypical locations with foot deformity, altered weight-bearing and poorly fitting footwear
EXAMPLE CASES

Neuropathic Only

T1
T2

Neuropathic Only

T1
STIR
T2

Neuropathic PLUS Osteomyelitis

Neuropathic and Early Osteomyelitis

T1
Gd

STIR
Gd

STIR
Gd

Gd

Gd

T2
CASE 8
43 year old with swelling, drainage from wound following below knee amputation (diabetes)
Are these normal post-amputation findings?
When should you call infection after an amputation?

Q: Is there Recurrent Infection after Amputation?

- Little metal artifact – no change in protocol needed
- Normal post-amputation marrow is completely normal
- Any signal alteration is suspicious

Normal Post-op Ostectomy

Post-op Wound Breakdown

Tract extends to bone

Transmetatarsal Amputation
Recurrent Osteomyelitis

Any signal at stump should be considered suspicious

Post op ACL Reconstruction
Septic Arthritis / Osteomyelitis

Post-op joint can have synovial enhancement, but should be mild, with no / minimal subchondral signal
DDX: reaction to components (e.g., bioabsorbable)
CASE 9
69 year old with THA 3 months ago, now painful especially with weight-bearing

How do you diagnose suspected infection of a prosthesis?
What is the differential diagnosis?

DDX
Loosening Migration

Osteomyelitis
Around Metal Rod

Prosthesis infection

PERIOSTITIS
MARROW ENHANCEMENT AROUND ROD
MARROW EDEMA

Stir
Gd
**PROSTHESIS IMAGING**

- Look for joint fluid / periarticular fluid collections, communication
- Complexity of fluid, rim enhancement
- Lower complexity, tracts - suggest infection
- High complexity, lower T2 signal - suggest ALTR

**CASE 10**
AIDS patient, immunocompromised; swelling, pain in lower leg
What are potential sources of muscle inflammation?
What is the differential?

**CASE 10**
What are potential sources of muscle inflammation?
What is the differential?

**DDX: Particle Disease**
Adverse local tissue reaction (ALTR)

**Adverse Local Tissue Reaction**
Metal-on-Metal Hip Implant:
MAVRIC SL demonstrates ALTR with markedly thickened synovial lining (arrow)

**PYOMYOSITIS**
**Polymyositis / Dermatomyositis**

- Inflammatory myopathies
- Family of autoimmune disorders
- Clinical: low grade fever, fatigue, muscle weakness
- MRI:
  - Early: muscle edema
  - Late: atrophy
- MRI useful to direct biopsy (edematous areas)

Lampa J, Ann Rheum Dis 2001; 60:423

**PYOMYOSITIS**

- Muscle edema
- Surrounding fascial / SQ inflammation
- Intramuscular abscesses

**AML with Pyomyositis**

**Candida myositis**

**Polymyositis**

**HIV+ Patient**

**STIR**

**MRI useful to direct biopsy (edematous areas)**
Diabetic Myonecrosis

- Insulin-dependent Diabetes Mellitus
- Thigh > calf, 40% bilateral
- Clinical – pain, swelling
- MRI:
  - Diffuse muscle edema / enlargement; focal fluid
  - Rim enhancement; central devitalization
  - Fascial edema, SQ edema
- Looks like abscess
- Keep in DDx in setting of uncontrolled diabetes

Jelinek JS, Radiology 1999; 211:241

Diabetic Myonecrosis

Gd

STIR

Thigh pain
Low grade fever
Normal WBC
Poorly controlled diabetes

Necrosis of Muscle Flap

Gd

T2

Gd

Gd

T2

Thank You!