

RADY 401 Case Presentation: Lower Extremity Osteomyelitis in Patient with Diabetes Mellitus

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5/14/2024

Focused patient history and workup

- 52 y.o. male with uncontrolled T2DM, s/p staged L Below-Knee Amputation (11/2022), CKD, chronic lower extremity edema who p/w 2 days of N/V and decreased PO intake in setting of 3 weeks of malodorous drainage from right foot. Drainage began 6 weeks ago. Has not removed shoe in 7 months.
- **VITAL SIGNS:** BP 132/86 | Pulse 79 | Temp 36.4 °C (97.5 °F) (Oral) | Resp 18 | Ht 195.6 cm (6' 5") | Wt (!) 123.5 kg (272 lb 4.3 oz) | SpO2 99% | BMI 32.29 kg/m²
- **PHYSICAL EXAM:** No acute distress. LLE with BKA. Skin on RLE warm, with erythematous circumferential rash, scabbing noted up to knee. Purulent discharge from R foot, dorsal pedis pulse not palpable. Large tissue defect in R heel. No frank crepitus. No sensation below knee
- **LABS:** CBC: Hgb 9.2 WBC 12.5 Plt 447
 - CMP: Cr 2.6 BUN 42 eGFR 29 Alb 2.5
 - ESR: >140
 - CRP: 113
 - BCx: +MRSA, coag-negative staph species (*S. hominis*, *S. epidermidis*, *S. capitis*, *S. cohnii*, *S. pettenkoferi*)

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- **LABS:** CBC: Hgb 9.2 **WBC 12.5** Plt 447
 - CMP: Cr 2.6 BUN 42 eGFR 29 Alb 2.5
 - **ESR: >140 mm/h (normal 0-15 mm/h)**
 - **CRP: 113 mg/L (normal <3 mg/L)**
 - **BCx: +MRSA, coag-negative staph species (S. hominis, S. epidermidis, S. capitis, S. cohnii, S. pettenkoferi)**

Imaging studies:

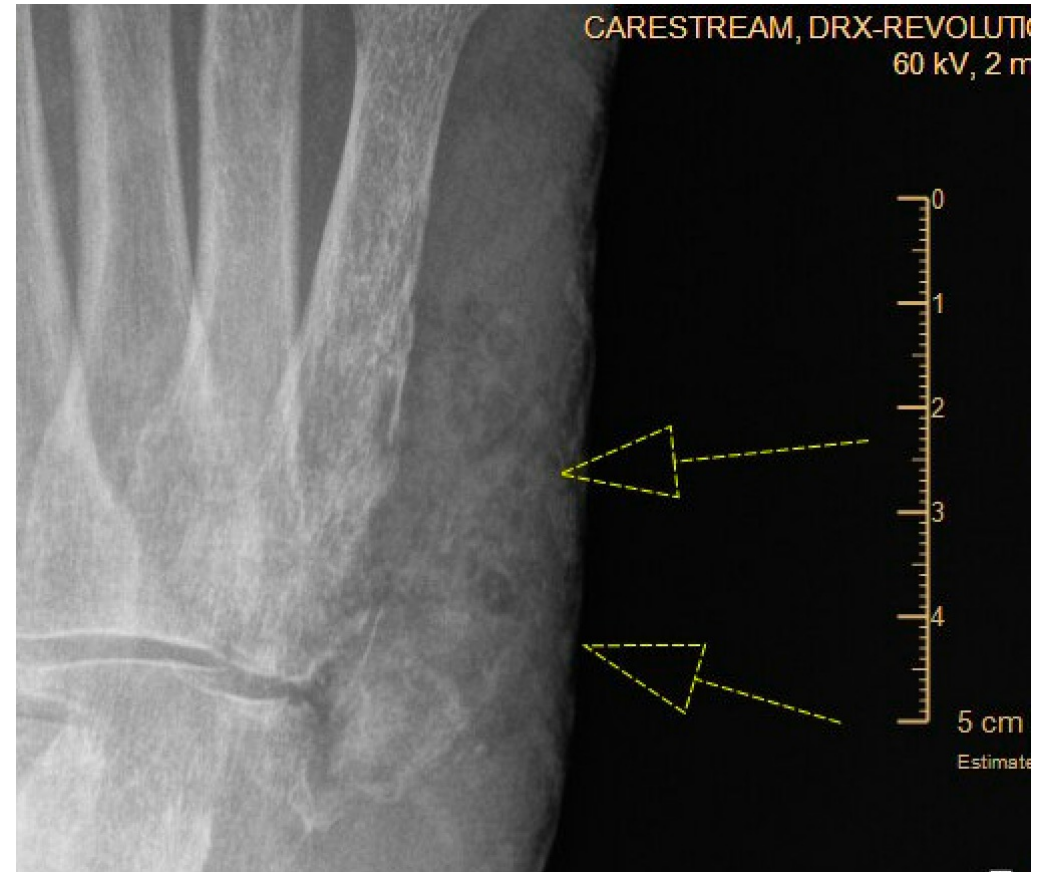
- XR Right Tibia / Fibula
- XR Right foot, 3 or more views
- Prior XR Left foot, 3 or more views
- MRI Foot, Osteomyelitis (Not of Patient)

Right Tibia / Fibula X-ray, AP and Lateral Views



“Diffuse soft tissue edema in the lower extremity with possible soft tissue defect overlying the distal anterior leg. No acute fracture or dislocation is identified”

Right Foot X-ray: AP View



Note the cortical destruction overlying the lateral aspect of the fifth metatarsal base and likely the lateral cuboid as well. Here (arrows) we can see soft tissue gas along the lateral aspect of the midfoot.

Right Foot X-Ray: Lateral, Oblique Views



Note the soft tissue defect over the distal anterior leg on (lateral view) left image. Diffuse soft tissue swelling of the lower leg, see 2nd metatarsal soft tissue defect

Left Foot X-ray, 2022 (AP View)



A review of this patient's prior left foot amputation from 2022 illustrates even more overt findings of osteomyelitis and necrotizing fasciitis:

“Focal osteopenia involving the fifth metatarsal head and neck (solid arrow). Focal osteopenia and a displaced, pathologic fracture of the base of the fifth proximal phalanx (dashed arrow). Irregular edges at the fracture site suggests involvement with infection

There is a large overlying soft tissue defect/ulcer, concerning for osteomyelitis. Extensive soft tissue gas tracking from the open wound to the soft tissues dorsal to the distal tibia and fibula, concerning for necrotizing fasciitis.”

Left Foot X-ray, 2022 (Lateral View)



The value of multiple views:
A lateral view of the previously-amputated left foot in 2022 illustrates soft tissue gas tracking even more clearly:

“Extensive soft tissue gas tracking from the open wound to the soft tissues dorsal to the distal tibia and fibula, concerning for necrotizing fasciitis.”

Imaging for Suspected Osteomyelitis in setting of Diabetes: ACR Appropriateness Criteria¹¹

- **Initial Imaging:** Plain Radiographs are usually appropriate
- Good for anatomic detail
- Degenerative changes
- Pathologic Fracture
- Foreign body
- Soft tissue gas
- Neuropathic arthropathy

American College of Radiology
ACR Appropriateness Criteria®
Suspected Osteomyelitis of the Foot in Patients with Diabetes Mellitus

Variant 1: Suspected osteomyelitis of the foot in patients with diabetes mellitus. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography foot	Usually Appropriate	⊕
CT foot with IV contrast	Usually Not Appropriate	⊕
CT foot without and with IV contrast	Usually Not Appropriate	⊕
CT foot without IV contrast	Usually Not Appropriate	⊕
FDG-PET/CT whole body	Usually Not Appropriate	⊕⊕⊕⊕
WBC scan and sulfur colloid scan foot	Usually Not Appropriate	⊕⊕⊕⊕
WBC scan foot	Usually Not Appropriate	⊕⊕⊕⊕
MRI foot without and with IV contrast	Usually Not Appropriate	○
MRI foot without IV contrast	Usually Not Appropriate	○
3-phase bone scan and WBC scan and sulfur colloid scan foot	Usually Not Appropriate	⊕⊕⊕⊕
3-phase bone scan and WBC scan foot	Usually Not Appropriate	⊕⊕⊕⊕
3-phase bone scan and WBC scan with SPECT or SPECT/CT foot	Usually Not Appropriate	⊕⊕⊕⊕
3-phase bone scan foot	Usually Not Appropriate	⊕⊕⊕
US foot	Usually Not Appropriate	○

Imaging for Suspected Osteomyelitis in setting of Diabetes: ACR Appropriateness Criteria¹¹

- **Following Radiographs, for suspected osteomyelitis of foot in patient with diabetes, soft tissue swelling with ulcer: Additional imaging with MRI is usually appropriate**

Variant 3:

Soft-tissue swelling with ulcer. Suspected osteomyelitis of the foot in patients with diabetes mellitus with or without neuropathic arthropathy. Additional imaging following radiographs.

Procedure	Appropriateness Category	Relative Radiation Level
MRI foot without and with IV contrast	Usually Appropriate	○
MRI foot without IV contrast	Usually Appropriate	○
CT foot with IV contrast	May Be Appropriate	⊛
CT foot without IV contrast	May Be Appropriate	⊛
3-phase bone scan and WBC scan foot	May Be Appropriate	⊛⊛⊛⊛
3-phase bone scan and WBC scan with SPECT or SPECT/CT foot	May Be Appropriate	⊛⊛⊛⊛
3-phase bone scan foot	May Be Appropriate (Disagreement)	⊛⊛⊛
FDG-PET/CT whole body	May Be Appropriate	⊛⊛⊛⊛
WBC scan foot	May Be Appropriate	⊛⊛⊛⊛
WBC scan and sulfur colloid scan foot	Usually Not Appropriate	⊛⊛⊛⊛
3-phase bone scan and WBC scan and sulfur colloid scan foot	Usually Not Appropriate	⊛⊛⊛⊛
CT foot without and with IV contrast	Usually Not Appropriate	⊛
US foot	Usually Not Appropriate	○

Example MRI Findings for Osteomyelitis⁷:



Coronal T1 Sequence



Coronal PD, Fat Saturated

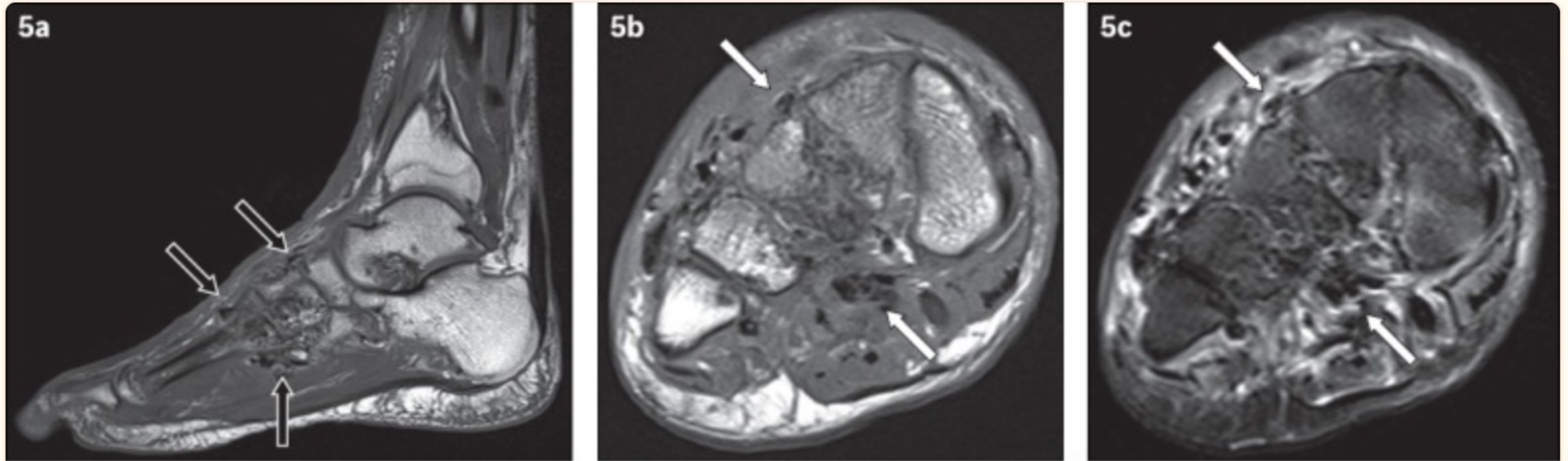
Example Read:

Extensive bone marrow signal changes (T1 hypointense, and PD hyperintense) involving the proximal fifth toe and fifth metatarsal head. Destruction of the 5th metatarsal head. Edematous changes within the forefoot intrinsic muscles and subcutaneous tissues.

Low T1 signal (compared to normal bone marrow, which is primarily fat) is consistent with osteomyelitis

Proton Density (PD) fat-saturated (suppressed) sequence improves contrast and visualization of non-fatty soft tissue structures, enhancing visibility of edema, and other pathologies in soft tissues.

MRI and Gas Gangrene¹⁰



- A: Sagittal T1-W MR image of the right foot shows low signal foci of magnetic susceptibility consistent with soft tissue gas formation along the fascial planes in the midfoot (black arrows), in keeping with soft tissue gas.
- B: Coronal T1-W MR image of same foot with similarly low signal focus of magnetic susceptibility consistent with soft tissue gas formation along fascial plane in the midfoot just superior to the third metatarsal (white arrow).
- C: Coronal T2-W MR image that is fat saturated, in same plane as image B, displaying the superior visualization of gas formation within soft tissues when fat is suppressed

Adapted from: Low KT, Peh WC. Magnetic resonance imaging of diabetic foot complications. Singapore Med J. 2015 Jan;56(1):23-33; . doi: 10.11622/smedj.2015006. PMID: 25640096; PMCID: PMC4325563.

Why MRI for Osteomyelitis^{8,9}?

Early Detection:

- It can detect early bone infection within 3 to 5 days of disease onset, but its use is limited in the setting of surgical hardware.
- A plain radiograph is usually the initial imaging of choice but may have a delay of about 14 days before the appearance of findings suggestive of osteomyelitis⁸.

High Specificity and Spatial Resolution:

- MRI has a high negative predictive value. A negative result is sufficient for the exclusion of disease if symptoms present for >1 week.
- The high resolution can delineate the anatomic extent of osteomyelitis (especially associated inflammatory changes) and assist in surgical planning

Osteomyelitis Imaging & Labs, Patients with Diabetes

- Radiographs²: Lower diagnostic accuracy
 - 16 studies: 61.9 % sensitivity (50.5-72.1); 78.3 % specificity (62.9-88.5)
 - Cost⁴:
 - XR foot, 3 view: \$432
 - XR Tib/Fib, 2 view: \$330
 - Radiation⁵: <0.1 – 1.8 mSv
- Labs⁶: High Likelihood of OM if:
 - Elevated ESR >60 mm/h sensitivity of 74% (95% confidence interval [CI], 67-80)
 - Elevated CRP >7.9 mg/dL sensitivity of 49% (95% CI, 41-57) and specificity of 80% (95% CI, 74-86).
- MRI²: High diagnostic accuracy
 - 22 studies: 96.4 % sensitivity (95 % CI 90.7-98.7); 83.8 % specificity (76.0-89.5)
 - Cost⁴:
 - Lower Ext, W/Wo Contrast: \$4978
 - Lower Ext other than Joint, w/o contrast: \$3462
 - Any joint lower extremity w/o contrast \$3431
 - Radiation⁵: None

Patient Outcome

- MRI unavailable at the outside facility, but severity of the presentation and X-ray findings were sufficient to move forward with surgical planning
- Broad-spectrum antibiotics (Vancomycin/Cefepime/Flagyl) were initiated and patient underwent right above-the-knee amputation at UNC Main.
- Intraoperatively, patient was confirmed to have osteomyelitis and path findings confirmed necrotizing fasciitis and gangrene of right lower leg
- Hospital course complicated by coag negative staph bacteremia
- Transitioned to acute inpatient rehab a week after surgery, discharged on hospital day 18

UNC Top Three: Suspected Osteomyelitis in DM

- X-ray imaging is an appropriate initial imaging test, and can provide adequate evidence to make clinical decisions in the right setting (clear/concerning labs or physical exam, chronic symptom history)
 - In this case it provided adequate information to move forward with surgery
- MRI is the most sensitive imaging modality for osteomyelitis, especially in detection of inflammation, fasciitis, myositis, fluid or gas collections, and areas of necrosis
- Just as important as the early detection of osteomyelitis, MRI provides the structural definition and high spatial resolution to evaluate the extent of infection that is often critical for surgical planning

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