A 46-year old man presents with pain in the left first metatarsophalangeal (MTP) joint

Neeharika Nallapati, OMS II TouroCOM
William Walter, MD NYU Langone MSK Diagnostic Radiology
Patient Presentation

• A 46 year-old man presents with pain, swelling, and limited range of motion in the left first metatarsophalangeal (MTP) joint
  ○ History of polyarthritis including both hands, wrists, and both feet
  ○ Did not adhere to previous diet and medication recommendations

• Radiographs were obtained to identify the specific cause of pain and guide further management

• Clinical differential diagnosis:
  • gout flare, osteoarthritis, inflammatory arthritis such as rheumatoid arthritis or septic arthritis
Pertinent Labs

Uric Acid level: 11 mg/dL
reference range: (3.4-7.0 mg/dL)
Select the applicable ACR Appropriateness Criteria

This imaging modality was ordered by the ER physician

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Appropriateness Category</th>
<th>Relative Radiation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiography foot</td>
<td>Usually Appropriate</td>
<td></td>
</tr>
<tr>
<td>US foot</td>
<td>Usually Not Appropriate</td>
<td></td>
</tr>
<tr>
<td>MRI foot without and with IV contrast</td>
<td>Usually Not Appropriate</td>
<td></td>
</tr>
<tr>
<td>MRI foot without IV contrast</td>
<td>Usually Not Appropriate</td>
<td></td>
</tr>
<tr>
<td>CT foot with IV contrast</td>
<td>Usually Not Appropriate</td>
<td></td>
</tr>
<tr>
<td>CT foot without and with IV contrast</td>
<td>Usually Not Appropriate</td>
<td></td>
</tr>
<tr>
<td>CT foot without IV contrast</td>
<td>Usually Not Appropriate</td>
<td></td>
</tr>
<tr>
<td>Bone scan foot</td>
<td>Usually Not Appropriate</td>
<td></td>
</tr>
</tbody>
</table>
Findings: Unlabeled Left foot radiographs - 3 standard projections
Findings: Labeled Left Foot Radiographs

- Cloud-like opacity and swelling at the medial aspect of the first metatarsophalangeal (MTP) joint: is suspicious for crystal deposition such as a gouty tophus (yellow arrow)

- Focal lucency of bone at the medial aspect of the first metatarsal head (blue arrow) is known as a marginal erosion, a typical finding in gout arthritis
What Imaging Should We Order Next?
A Dual energy CT was ordered due to specific concern for gout.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Appropriateness Category</th>
<th>Relative Radiation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI foot without IV contrast</td>
<td>Usually Appropriate</td>
<td>0</td>
</tr>
<tr>
<td>US foot</td>
<td>May Be Appropriate</td>
<td>0</td>
</tr>
<tr>
<td>MRI foot without and with IV contrast</td>
<td>May Be Appropriate</td>
<td>0</td>
</tr>
<tr>
<td>CT foot without IV contrast</td>
<td>May Be Appropriate</td>
<td>⚫</td>
</tr>
<tr>
<td>Bone scan foot</td>
<td>May Be Appropriate</td>
<td>☢</td>
</tr>
<tr>
<td>CT foot with IV contrast</td>
<td>Usually Not Appropriate</td>
<td>⚫</td>
</tr>
<tr>
<td>CT foot without and with IV contrast</td>
<td>Usually Not Appropriate</td>
<td>⚫</td>
</tr>
</tbody>
</table>
Findings: Labeled CT images from a Left Foot Dual Energy CT

Yellow arrow: tophus

Blue arrow: marginal erosion in the 1st metatarsal head
Findings: Unlabeled Left foot Dual Energy Computed Tomography (DECT)

• 3-dimensional reconstructed images of the left foot using DECT with post-processing to label monosodium urate crystals in green.

• The purple coloration occurs at sites of trabecular bone, a normal finding.
Findings: labeled Left foot Dual Energy Computed Tomography (DECT)

- Green-labeled monosodium urate crystal deposition around the 1st MTP joint indicates a tophus (yellow arrow)

- Additional sites of tophus including around the ankle joint (blue arrow)
Findings: Comparing the X-ray and DECT images...

- Tophus around the ankle is difficult to visualize on radiographs (red arrow)

Extent/Severity of the tophus is difficult to confidently assess by radiographs alone
Final Dx:

Gouty Arthritis
Case Discussion

• Gout is a common form of inflammatory arthritis where monosodium urate crystals are deposited into joints rising prevalence: currently affects 1-2% of men in developed countries
  • commonly associated with diabetes, hypertension, and metabolic syndrome
• Diagnosis: Physical exam, elevated serum uric acid level
  • invasive techniques like arthrocentesis and synovial biopsy provide definitive diagnosis
• First-line imaging study: radiographs of the involved joint(s)
  • Ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) can be useful in some cases
  • Dual energy CT (DECT) is non-invasive and provides definitive diagnosis

Our patient underwent a dual energy computed tomography (DECT) scan to confirm the diagnosis and assess the extent of tophus throughout the foot.
Case Discussion

- Radiographs are the first line imaging modality to diagnose arthritis of any type, including gout
  - Radiographs provide excellent resolution of bones and accurately depict mineralization such as deposits of calcium or other crystals
  - Thus radiographs can accurately detect tophus and erosions

- DECT is a non-invasive imaging technique to confidently identify, locate, and quantify monosodium urate deposition in patients with gout
  - DECT uses two X-ray beams of different photon energies
  - Differences in energy absorption are calculated and used to accurately determine the chemical composition of the intervening materials along the X-ray beams
  - Quantification of tophus can be a useful way to track treatment response in patients with gout
References:

