Crystal Deposition Diseases

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Case 1. 58y, F, wrist pain for 2 weeks.

Diagnosis: Pyrophosphate Arthropathy

- Inflammatory Arthritis
- CPPD crystals are pro-inflammatory particles
- Can cause synovial inflammation

T2 fat saturation
Calcium Pyrophosphate Dihydrate (CPPD) Crystals Normally Deposit in MSK System

CPPD sporadic deposit of CPPD is a common condition in the Elderly
- 8-10% of people aged 60 years. 20-40% at age 80y

Picture from UCSD Research Lab 2002
Berna\textsuperscript{1,2}, Abreu\textsuperscript{2}, Resnick\textsuperscript{2}. UCSD study presented at ECR 2011
An association between OA and CPPD is well recognized however…
  - the precise relationship is unclear!
  - CPPD is a cause of OA or develops as a consequence of the cartilage changes that accompany OA?

From: UCSD research lab
CPPD and OA

causative factor or consequence?

CPPD may be a marker of a reparative process by metabolically active chondrocytes.

➔ 100 patients who had undergone unilateral meniscectomy (20 year)
➔ showed CPPD in 20% of operated knees compared with 4% of contralateral unoperated knee

the suggestion that CPPD could be a marker of poor prognosis in knee OA was not confirmed in several other longitudinal studies

How accurate is MR imaging for CPPD deposits?
Faxitron radiograph of cadaver specimen
Sagittal PD-weighted MR image of same spec

CHONDROCALCINOSIS

Abreu, Chung CB, Resnick D. CPPD crystalline deposits in the knee: anatomic, radiographic, MR imaging, and histologic study in cadavers. Skel Rad 2004
Calcium Pyrophosphate Dihydrate (CPPD) Normally Deposits in SPINE (discs, lig., joints)

- 26% of autopsies studies.

- In the **cervical** spine, serious complications have been reported
  - cervical myelopathy (calcification of cervical ligamentum flavum, transverse ligament of the atlas, odontoid fracture.

*Resnik & Niwayama*

Case 2. 77y, W, occipital pain, motion limitation, myelopathy

Crowned Dens Syndrome

Exaggerated CPPD Deposition at C1-C2
MR imaging diagnostic features in joint CPPD

- CPPD commonly encountered in elderly asymptomatic
- MR has low accuracy for CPPD deposits
- MR detects **Inflammatory Arthropathy** (synovitis, pannus), but needs correlation with x-ray or CT for final diagnosis
Case 3. 40y, M, Shoulder pain for 1 week.

**Calcific Tendinitis (Hydroxyapatite)**

- Common in asymptomatic persons (when confined)
- Most commonly: Supraspinatus tendon insertion
- Less common: tendons of infraspinatus, subscapularis, deltoid, wrist, elbow, gluteus maximus, knee, and neck.
- Inflammation and edema can occur
How accurate is MR imaging for Hydroxyapatite deposits?
Hydroxyapatite Crystal Deposition

Low Accuracy of MR: 62%-66%

Manny False Negatives and False Positives of MR

Zubler et al. MRA in Calcific Tendinitis Eur Radiol 2006
Hydroxyapatite Crystal Deposition

Accuracy of MR increases with inflammation
Case 4. 47y, F, Shoulder pain for 3 weeks.

T1

GRADIENT T2*

MR-Angio (GAD)
Case 5. 63y, F, Pain for 1 month, high VSG and RCP

Hydroxyapatite Crystal Deposition

Bone migration, inflammatory response
Disc Hydroxyapatite Crystal Deposition

- *Intervertebral Disc Apatite*
- *Phosphocalcic Bruschite*
- *Apatite Rheumatism*

Can also be secondary to:

- Disk Steroid Injections
- Hemodialysis
- Ochronosis
Apatite x CPPD

morphology of calcification

Round dense calcification
Cloud like appearance

Linear "CROWNED DENS"
Differentiate from:
Destructive Discoveredtebral Deg Disease (DDDD)

Malalignment
Degenerative Disc Loss
End-plate failure
“bone sand” within the spinal canal.

Charran, Puliccino V. Destructive discovertebral degenerative disease of the lumbar spine. Skel Rad 2012
MRI in Hydroxyapatite

- MR detects Inflammatory changes when deposits migrate from quiescent stage to bone or soft tissue
- Spine cases can be more challenging
- CT correlation very helpful
- Need better MR sequence to see bone/calcium would help (Zero TE)

Case 6. 62y, M, Hallux pain and edema

Monosodium Urate Crystal Deposition (Gout)

- Cumulative crystal deposition is frequently clinically silent, as CPPD, Hydroxyapatite
- Genetic predisposition 1%–2% of the population.
- Crystal deposition in and around joints, and tendons.
- Serum urate exceeding the physiologic saturation threshold (380 mmol/L)

Acute gouty arthritis:
LOWER LOMB joints (85%–90% of cases)
FIRST MTP joint (PODAGRA)
The disease has four phases:
1. Asymptomatic hyperuricemia
2. Acute
3. Intercritical
4. Chronic
Monosodium Urate Crystal Deposition (Gout)
Case 9. 69y, M, back pain and radiculopathy.

Rheumatological Protocol: T1, STIR 3 planes, and axial T1 and T2
Case 10. 47y F, Cauda Equina Syndrome

- Hydroxyapatite Crystal Deposition
- Ossification of the Posterior Long Lig
- 'Bone Sand' in DDDDD
- Gout
Monosodium Urate Crystal Deposition (Gout)

Early stage diagnosis of Inflammatory Arthropathy

STIR, MOST SENSITIVE
Monosodium Urate Crystal Deposition (Gout)

Early stage diagnosis of Inflammatory Arthropathy

MR-ANGIO, BETTER

STIR, MOST SENSITIVE
Early stage diagnosis of Inflammatory Arthropathy
Case 7. 40, M, Local pain for 15 days. No trauma or hiperuricemia.
Case 8. Wrist pain for 24 days. No trauma or hiperuricemia.
Dual Energy CT in GOUT

COTICAL BONE
URATE
IODINE
DUAL ENERGY CT in Gout

- Important Imaging Method for Diagnosis and Follow-up
- Very small Radiation Exposure: 0.5mSv/joint

2. Savvakis N. AJR 2010

Courtesy of Dr Skaf A
Summary
Crystals Deposition Diseases

• **CPPD, Hydroxyapatite** and **Urate**: *can be silent*

• When activated, various clinical scenarios can be found:
  – Acute/Chronic/Intercritical Inflammatory Arthritis
  – Inflammatory Tendinopathy/Bursitis
  – Back Pain, Compressive Myelopathy

MR imaging is a very useful imaging method for the diagnosis of those diseases, most of the time together with other methods like CT, DE-CT
Crystal Deposition Diseases

Thank You

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