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Imaging in Crystalline Arthritis

Announcer:

You're listening to ReachMD. This episode of *Living Rheum*, titled "Imaging in Crystalline Arthritis" is sponsored by Novartis US Clinical Development and Medical Affairs. The speakers have been compensated for their time. This program is intended for healthcare professionals. Here's your host, Dr Jason Liebowitz.

Dr Liebowitz:

Is there a way to better understand conditions like gout and calcium pyrophosphate deposition disease, or CPPD, beyond what's seen in synovial fluid? Advances in imaging may bring us closer to identifying these diseases more accurately.

This is ReachMD, and I'm Dr Jason Liebowitz. Joining me to explore the role of imaging in crystalline arthritis is Dr Sara Tedeschi. Dr Tedeschi is an Assistant Professor of Medicine at Harvard Medical School and Associate Physician at Brigham and Women's Hospital. She also serves on the American College of Rheumatology Committee on Quality of Care. Dr Tedeschi, thanks for being here today.

Dr Tedeschi:

Thanks for having me.

Dr Liebowitz:

To start us off, Dr Tedeschi, can you share some of the hallmark features of conditions such as gout and CPPD disease as seen on conventional radiography?

Dr Tedeschi:

Sure, I'm happy to. On conventional radiography, gout can be identified with a number of features. Some of these include bone erosions that are referred to as rat bite erosions, because they have overhanging edges and a sclerotic rim, and these are typically seen in patients that have longstanding gout. We also can see bony proliferation and joint space narrowing, which occurs late in the disease course. And then we can also see sometimes evidence of tophi which would potentially show up as soft tissue masses which can be calcified.

Now turning to manifestations of CPPD disease, chondrocalcinosis, or cartilage calcification, is the hallmark finding. And this presents as mineralization in hyaline cartilage or fibrocartilage that's related to the deposition of calcium pyrophosphate most commonly, it can also potentially be related to other calcium crystals. Chondrocalcinosis is most frequently seen on radiographs of the knee, and also in the wrist, especially in the triangular fibrocartilage complex. But it should be noted that chondrocalcinosis on x-ray has a moderate sensitivity, only about 50%, when we use synovial fluid crystal analysis as the gold standard. So that means that many patients that have CPPD deposition are not going to have a positive x-ray with chondrocalcinosis.

Other features of CPPD disease that could be seen on a plain radiograph would include a joint effusion if it's large, soft tissue swelling during acute flares, and then in the metacarpal phalangeal joints, or the MCP joints, we have certain findings that include hook-like osteophytes. These can also be seen in other conditions like hemochromatosis, and this is particularly in the second and third MCPs, as well as osteoarthritis at the second and third MCPs. We also can see osteoarthritis in unusual joints for primary osteoarthritis, for example, the shoulders.

Dr Liebowitz:

Thank you so much for that summary. What would you say is the role of ultrasound in evaluation of these conditions?

Dr Tedeschi:

Ultrasound of patients with suspected gout focuses on identifying monosodium urate crystal deposition in the joints and the soft tissues. Some of the

ultrasonographic findings include the double contour sign, which looks like a tram track where the monosodium urate crystals are layering on top of hyaline cartilage. And we can also see aggregates or clusters of crystals, we can see tophi, which are heterogeneous appearing, and we can see erosions on bone.

In CPPD, ultrasound has proven to be quite sensitive and specific. And so, ultrasound can be used in CPPD to look for calcium pyrophosphate crystal depositions that can be embedded within the substance of hyaline cartilage. This is opposed to gout, where the monosodium urate crystals are layering on top of the cartilage, and CPPD these calcium crystals are in the cartilage. Calcific deposits can also be seen in the triangular fibrocartilage in the wrist and in the menisci in the knee and sometimes in tendons. Chondrocalcinosis can be detected on ultrasound even when it's not detectable on conventional radiograph, which means it's probably a better test when a patient is presenting with early CPPD.

Dr Liebowitz:

Excellent. Now let's take a look at dual energy CT imaging, or DECT for short. What kind of role does it have in evaluating patients with crystalline arthritis?

Dr Tedeschi:

Dual energy CT is well-established as a sensitive and specific modality for gout, but data is still emerging for CPPD disease. And it still remains unclear if dual energy CT provides better sensitivity or specificity in CPPD, compared to just a conventional CT scan.

Dual energy CT can acknowledge differences in tissue composition, and it color-codes tissues with specific features, a specific, what's called dual energy index, which has to deal with how 2 x-ray beams are diffracted by a particular material. And software can be applied to take advantage of this diffraction ratio. And it can identify, for example, monosodium urate crystals, and it can distinguish them from other types of crystals, like calcium pyrophosphate.

Dual energy CT can be really helpful in cases when there is diagnostic uncertainty, especially in joints that are difficult to aspirate or where aspiration has not been successful. And the first MTP joints and the patellar tendons appear to be sites where dual energy CT can be most helpful to identify definite monosodium urate depositions.

It's worth noting, though, that when evaluating gout patients, that dual energy CT is subjected to artifacts. So, for example, the nail beds or hyperkeratinized skin can sometimes show up as positive when you're looking at these images. And so, it's important to keep that in mind and to interpret these with a skilled radiologist who knows how to differentiate between these artifacts and actual monosodium urate deposits.

Some of the studies have shown that dual energy CT is quite sensitive with longstanding gout in patients who have had, you know, the accumulation of monosodium urate deposits over time, but it's a little bit less sensitive in patients with new-onset gout.

Dr Liebowitz:

Thank you, that's incredibly helpful. And what can you tell us about the role of imaging in crowned dens syndrome?

Dr Tedeschi:

Before I dive into that, I just want to touch, quickly, on crowned dens syndrome in general. Crowned dens syndrome is a clinical syndrome that is a combination of clinical symptoms with radiographic features to support this diagnosis. It's an inflammatory condition that results from calcium pyrophosphate crystals being deposited in the cruciform and alar ligaments that are around the dens, which is on the C2 vertebral bone, and these calcifications appear as a radio-opaque crown that's around the top of the dens. It typically presents in an older adult with severe neck pain, limiting their ability to move their neck, increased inflammatory markers, they may have fever, and, you know, for all intents and purposes, it may look like they have meningitis.

The key radiographic finding is the presence of calcification around the dens. This is going to appear above and to the sides of the dens in a crown or a halo configuration. Conventional CT is the gold standard for identifying these calcifications and confirming that the location corresponds to these periodontal ligaments, particularly in the transverse ligament of the atlas, which is part of the cruciform ligament.

Importantly, MRI is not sensitive to detecting these calcifications. MRI can demonstrate inflammatory changes and potentially any spinal cord involvement, but it's not going to identify the calcifications.

So, a key condition that's often discussed when someone's getting imaging to evaluate for crowned den syndrome is rheumatoid arthritis, because of the involvement around the dens. And there can be pannus that forms around the dens either in rheumatoid arthritis or in crowned dens syndrome.

A key discussion when someone is having imaging for crowned dens syndrome is often whether the patient might have rheumatoid arthritis because of the involvement of the dens and the pannus formation around the dens. So, the distinction is whether the typical calcifications are present and also whether the typical symptoms are present. You cannot diagnose crowned dens syndrome if a person just has these radiographic findings. They also need to have that acute neck pain, you know, raised inflammatory markers, potentially fever, etc.

An MRI might show pannus in these patients or not, and so again, the real distinction here between rheumatoid arthritis and crowned dens syndrome is often the acuity of the presentation and then the presence of these calcifications in these ligaments around the dens.

Dr Liebowitz:

Thank you so much for that expert discussion. So, as we look towards the future, how will incorporating imaging of crystalline arthritis impact evaluation of patients?

Dr Tedeschi:

This is an exciting area because new modalities that can distinguish between different types of crystals with greater specificity, such as multiphoton spectral CT, and they can identify very, very minute deposits of crystals, are going to aid in diagnosis. Potentially, I could see a time in the future when these types of imaging modalities could potentially avoid the need for synovial fluid aspiration in a person who's presenting with chronic symptoms, you know, where there's not a suspicion for septic arthritis. But where there is a chronic symptom, aspiration hasn't been either attempted or it's been attempted and unsuccessful, and we may be able to use imaging modalities, that are sensitive and specific enough to aid with the diagnosis. And I think this is already happening with dual energy CT in gout, and I think it's also happening to some extent with ultrasound for CPPD.

As technology continues to develop, I think there's going to be increased availability and usage of ultrasound, especially in the United States. Right now, it's really being widely used in Europe, but I think that the ultrasound uptake has been a little bit slower here. And I think there's the potential for using handheld ultrasounds or small devices that can attach to a smartphone, making it increasingly accessible, and it probably will become increasingly part of rheumatology fellowship training. I think also that the potential for decreased costs of some of these very large and expensive scanners may potentially increase the use of dual energy CT imaging.

Dr Liebowitz:

Wonderful. And with those forward-looking thoughts in mind, I want to thank my guests for helping us better understand imaging in crystalline arthritis. Dr Tedeschi, it was a great pleasure speaking with you today.

Dr Tedeschi:

Thanks for having me join you.

Announcer:

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