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DECT FOR GOUT DIAGNOSIS

This report combines gout research and Siemens press release (May 2009) information about a non-invasive gout diagnosis – DECT (Dual Energy Computed Tomography)

NEW DIAGNOSTIC METHOD FOR GOUT: DUAL ENERGY COMPUTED TOMOGRAPHY INSTEAD OF JOINT ASPIRATION

The most reliable method of diagnosing gout is to draw fluid from the joint (arthrocentesis) to verify the presence of monosodium urate crystals (uric acid). Up to now, computed tomography (CT) has played a limited role in the evaluation of gout, since conventional CT systems cannot reliably verify deposits of uric acid. However, a current study at the

Vancouver General Hospital in Canada gives rise to speculation that dual-energy computed tomography (DECT) could radically change the diagnosis of this disease. DECT enables fast, noninvasive examinations and, based on initial evaluations, has the potential to surpass the invasive gold standard and clinical examination in terms of reliability.

Investigations have confirmed the high sensitivity of the DECT method in detecting uric acid deposits. The Canadian scientists used the SOMATOM Definition computed tomography (CT scanner) from Siemens for their investigation. This system is the only CT scanner worldwide that features two X-ray tubes capable of simultaneously producing different energies.

Gout is the most widespread form of crystal arthropathy and the most common inflammatory joint disease in men. It is caused by the deposition of uric acid crystals in joints and predominantly occurs among men. 2.1 million people in the USA and some 1.5 million people in Germany are currently afflicted by this painful, destructive disease. Furthermore, due to our eating habits, these figures are constantly increasing.

The classical symptoms of gout are painful, visibly swollen joints. Gout is nevertheless difficult to diagnose, since quite a few diseases, for example various forms of arthritis, have similar symptoms. While imaging techniques can help to locate gout lesions, the specificity of X-ray, single-source computed tomography, magnetic resonance imaging and ultrasound is not sufficient to definitively confirm a diagnosis. Certainty can be achieved only by verifying the presence of monosodium urate crystals, also called uric acid deposits (tophi), in and around the joint. This is done by aspirating the joint with a needle to remove the fluid, which is then microscopically analyzed under polarized light. A joint puncture may be difficult with acutely inflamed joints, since the amount of fluid available may not be sufficient for this purpose. Furthermore, some anatomical regions are difficult to access, for example in the spinal region. A noninvasive diagnostic technique is therefore extremely desirable.

The prospect of a fast, safe and noninvasive diagnosis of gout using dual-energy computed tomography (DECT) has sparked great interest in Canada. In collaboration with Siemens, Dr. Savvas Nicolaou, Director of Emergency Radiology at Vancouver General Hospital and Associate Professor at the University of British Columbia in Vancouver, and both his radiology and rheumatology colleagues developed a dual-energy algorithm for identifying uric acid deposits.

The Canadian scientists used a SOMATOM Definition from Siemens for their trials. This system is the only CT scanner worldwide that features two X-ray tubes capable of simultaneously producing different energies. The team performed scans at different energies to determine the attenuation values of uric acid deposits. Siemens used this data to develop a new dual-energy protocol for gout that now can be used by any physician. The software algorithm used to detect gout via DECT is based on the realization that the CT values of uric acid deposits are lower, for instance, than those of calcium if scans are performed at different energies (80 and 140 kilovolts). Through color coding of the different attenuation values, it then

DUAL ENERGY COMPUTED TOMOGRAPHY IN TOPHACEOUS GOUT

Objective: To evaluate the potential utility of a dual energy CT (DECT) scan in assessing urate deposits among patients with tophaceous gout, and obtain computerized quantification of tophus volume in peripheral joints.

Methods: 20 consecutive patients with tophaceous gout and 10 control patients with other arthritic conditions were included. DECT scans were performed using a renal stone color-coding protocol that specifically assessed the chemical composition of the material (i.e., urate colored in red, calcium colored in blue). An automated volumetric assessment of DECT was used to measure the volume of urate deposits in all peripheral joint areas.

Results: All 20 patients with gout showed red color-coded urate deposits on their DECT scans, whereas none of 10 controls showed urate deposits. DECT scans revealed a total of 440 areas of urate deposition in 20 patients, whereas physical examination showed 111 areas of urate deposition (mean 22 vs 6 per patient, respectively, $p<0.001$). Total urate volume in a given patient ranged from 0.63 cm^3 to 249.13 cm^3, with a mean of 40.20 cm^3.

Conclusions: DECT scans can produce obvious color displays for urate deposits and help to identify subclinical tophus deposits. Furthermore, tophus volume can be measured by DECT scans through an automated volume estimation procedure.

becomes possible to recognize mono sodium urate crystals on the clinical CT image: The uric acid crystals indicating gout are, for example, color coded in red, while other bone formations and calcium are displayed in blue. The commercial version of the Siemens application is called Syngo DE Gout.

In a further study, Dr. Nicolaou and his colleagues investigated whether DECT can be used reliably to confirm the presence of gout tophi, whether DECT is superior to the traditional clinical examination i.e. detecting subclinical urate deposits, and whether this modality can clarify cases of doubt as problem solving tool. Ten patients were recruited who already had been diagnosed with gout by means of joint puncture with aspiration of synovial fluid and 10 control patients that did not have gout clinically. The patient records of all patients were analyzed and all patients underwent a complete rheumatological examination and DECT. The evaluation of the DECT images was performed by two radiologists working independently of one another.

DUAL-ENERGY CT AS A POTENTIAL NEW DIAGNOSTIC TOOL IN THE MANAGEMENT OF GOUT IN THE ACUTE SETTING

Objective: Gout is the most common crystal deposition arthropathy currently diagnosed clinically and with arthrocentesis. Dual-energy CT is a promising new imaging technique offering potential new applications in a number of clinical areas.

Conclusions: The ability of dual-energy CT to diagnose early gout and its use as a problem-solving tool is shown here. Diagnosis of subclinical gout could avert associated long-term complications, thereby reducing disease burden and improving overall quality of life.

This study showed that the DECT images of all patients proven to have gout yielded correspondingly positive findings in the aspirated joints. The DECT images of the control group all showed negative findings. "Our findings indicate that deposits of mono sodium urate crystals can be detected sub clinically more efficiently using DECT than with the traditional clinical examination," says Dr. Nicolaou. The fact is that more areas involved with gout were found overall per DECT than through the other clinical examination ,i.e. 200 sites with DECT versus 53 sites clinically, i.e. four times more foci were revealed with DECT($p < 0.05$). Furthermore, it has become evident that DECT can detect the presence of gout in hands, wrists feet, ankles, knees significantly better than the traditional clinical examination. DECT did not achieve significantly better results in the detection of gout in the elbow.

In addition, the study also provided new information on the presence of subclinical tophi and the accumulation of monosodium urate crystal deposits in clinically challenging anatomic regions. "To our surprise, the study showed that uric acid can be initially deposited in tendons and ligaments near and within the knee joint, ankle joint ,wrist , i.e. in the collateral ligament / cruciate ligament and deep flexor tendons of the wrist", says Dr. Nicolaou. "This is very important to know, since these deposits can increase the susceptibility of tendons and ligaments for tears. If we are able to detect the disease in an early stage, we can initiate a treatment to prevent destruction of the tendons and ligaments and joints where subclinical tophi are present."

"DECT is a promising new technique, that can in a reliable, noninvasive fashion confirm the presence of gout tophi subclinically that surpasses the sensitivity of clinical examinations, provides information on

the patient's disease burden and enables differentiation from other diseases. This technique may be used for monitoring treatment success and can be used to resolve unclear cases", says Dr. Nicolaou.

GoutPal Observations

It is clear that, as well as being a superb diagnostic tool, these studies clarify earlier research using advanced imaging techniques, showing extensive buildup of uric acid crystals, even in joints that have not (yet) shown clinical signs of gout.

The implications for gout sufferers are:

- Lowering uric acid is more important than generally recognized. The policy of waiting for several acute gout attacks before commencing urate lowering therapy is outdated, especially given these clear indications that tendon damage takes place prior to acute gout flares.
- Urate lowering therapy may precipitate acute gout in previously unaffected joints where deposits have grown too slowly to instigate an inflammatory reaction but suddenly start to dissolve in bulk. Partially dissolved crystals, common in all uric acid lowering treatments, will cause acute gout attacks if present in sufficient numbers.

For more information, see the gout diagnosis reference pages for DECT information and other diagnostic techniques; the gout treatment reference pages for uric acid lowering treatments; and the uric acid reference pages for information about how and why urate deposits form.