

Ultrasound imaging for the rheumatologist

XXV. Sonographic assessment of the knee in patients with gout and calcium pyrophosphate deposition disease

E. Filippucci¹, C.A. Scirè², A. Delle Sedie³, A. Iagnocco⁴, L. Riente³, G. Meenagh⁵, M. Gutierrez¹, S. Bombardieri³, G. Valesini⁴, C. Montecucco², W. Grassi¹

¹Cattedra di Reumatologia, Università Politecnica delle Marche, Ancona, Italy;

²Cattedra di Reumatologia, IRCCS Policlinico San Matteo, Università di Pavia, Pavia, Italy;

³Unità Operativa di Reumatologia, Università di Pisa, Pisa, Italy;

⁴Cattedra di Reumatologia, Sapienza Università di Roma, Roma, Italy;

⁵Department of Rheumatology, Antrim Hospital, Antrim, United Kingdom.

Emilio Filippucci, MD

Carlo Alberto Scirè, MD

Andrea Delle Sedie, MD

Annamaria Iagnocco, MD

Lucrezia Riente, MD

Gary Meenagh, MD

Marwin Gutierrez, MD

Stefano Bombardieri, MD, Professor of Rheumatology

Guido Valesini, MD, Professor of Rheumatology

Carlomaurizio Montecucco, MD, Professor of Rheumatology

Walter Grassi, MD, Professor of Rheumatology

Please address correspondence to:

Prof. Walter Grassi,

Cattedra di Reumatologia,

Università Politecnica delle Marche,

Ospedale "A. Murri",

Via dei Colli 52,

60035 Jesi (Ancona), Italy.

E-mail: walter.grassi@univpm.it

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ABSTRACT

The knee is a frequent target for gout and calcium pyrophosphate dihydrate (CPPD) disease with involvement of both articular and peri-articular structures. The aims of the present study were to investigate the relationship between clinical and ultrasound (US) findings and to describe the prevalence and distribution of crystal deposits in the knee in patients with gout and CPPD disease. Thirty patients with gout and 70 patients with CPPD disease were enrolled in the study. Prior to US assessment all patients underwent a clinical examination by an expert rheumatologist who recorded the presence/absence of pain, tenderness (evoked by palpation and/or active or passive mobilisation of the knee), and knee swelling. US examinations were performed using a Logiq 9 (General Electric Medical Systems, Milwaukee, WI) equipped with a multifrequency linear probe, working at 9 MHz. Two hundred knee joints were investigated in a total of 100 patients. Fifty-one (25.5%) knee joints were found clinically involved, while at least one US finding indicative of joint inflammation was obtained in 73 (36.5%) knee joints.

The most frequent US finding indicative of knee joint inflammation was joint effusion, detected in 21 (35%) out of 60 knees and in 52 (37%) out of 140 knees, in gout and CPPD disease, respectively. Ten (17%) out of 60 knees and 21 (15%) out of 140 knees were found positive for synovial hypertrophy with or without intra-articular power Doppler, in gout and CPPD disease respectively. Sonographic evidence of crystal deposition within joint cartilage (hyaline and fibrocartilage) was

more frequently seen than in the soft tissue in the knee.

This study demonstrated that US detected a higher number of inflamed knee joints than clinical assessment in patients with crystal related arthropathies and that the distribution of crystal deposits at joint cartilage level permitted distinction between gout and CPPD disease. Further studies are required to investigate both sensitivity and specificity of US features indicative of crystal aggregates at both tendon and entheseal level.

Introduction

Although ultrasound (US) is widely considered to be an excellent technique for quick and accurate assessment of patients with various rheumatic diseases (1-8), only few studies have addressed its diagnostic ability in crystal-related arthropathies (9-18).

The knee is a frequent target for gout and calcium pyrophosphate dihydrate CPPD disease with involvement of both articular and peri-articular structures (19).

The aims of the present study were to investigate the relationship between clinical and US findings and to describe the prevalence and distribution of crystal deposits in the knee in patients with gout and CPPD disease.

Methods

The study was conducted according to the Declaration of Helsinki and local regulations and informed consent was obtained from all patients.

Patients

Thirty patients with gout and 70 patients with CPPD disease, attending the out-

Table I. Demographic and clinical data.

	Gout	CPPD disease
Number of patients	30	70
Gender (female/male)	2/28	55/25
Age in years (median; 95% CI for the median; SD; range)	59; 56-66; 10.6; 42-79.	66; 62-68; 9.8; 36-84.
Disease duration in years (median; 95% CI for the median; SD; range)	6; 5-7; 4.2; 3-20.	6; 5-7; 5.8; 2-30.

CI: confidence interval; SD: standard deviation.

Table II. Scanning technique adopted for the study.

Scanning planes under examination	Position of the patient	Anatomic structures
Anterior transverse and longitudinal scans	Patient in supine position with the knee in neutral extended position and with the knee semiflexed at 45°	Supra-patellar pouch Quadriceps and patellar tendons and entheses
Anterior supra-patellar transverse and longitudinal scans	Patient in supine position with the knee in maximal flexion (>90°)	Hyaline cartilage of the femoral trochlea and the anterior portion of the femoral condyles
Anterior para-patellar transverse and longitudinal scans	Patient in supine position with the knee in maximal flexion (>90°)	The lateral portion of the hyaline cartilage of the femoral condyles
Lateral and medial transverse and longitudinal scans	Patients in supine position with the knee in neutral extended and in maximal flexion positions.	The external portion of the menisci
Posterior transverse and longitudinal scans	Patient in prone position with the knee in neutral extended position.	Hyaline cartilage of the posterior portion of the femoral condyles. Gastrocnemius-semimembranosus bursa

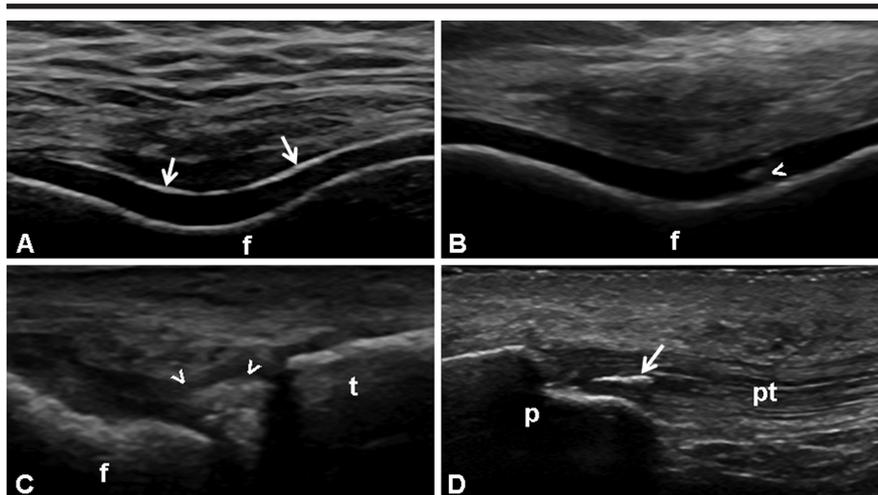


Fig. 1. Classical sonographic findings of crystal deposits in the knee. **A.** Gout. Hyperechoic enhancement of the chondro-synovial interface due to monosodium urate crystal deposition on the cartilage surface (**arrows**). **B.** CPPD disease. Pyrophosphate crystal deposition within the hyaline cartilage appearing as hyperechoic spots (**arrowhead**) which do not generate acoustic shadowing. **C.** CPPD disease. Meniscal calcification appearing as a hyperchoic triangle-shaped area (**arrowheads**) between the femoral and tibial condyles. **D.** CPPD disease. Enthesal thickening and hyperechoic linear band without acoustic shadow located within the proximal patellar insertion into the lower pole of the patella (**arrow**). **f** = femur; **t** = tibia; **pt** = patellar tendon; **p** = patella.

patient clinics and in-patient facilities of the Rheumatology Departments involved in this multicentre observational study were consecutively enrolled in the study. The diagnoses have been formulated according to international criteria: the American Rheumatism Association guidelines for gout and McCarty criteria for CPPD disease (20, 21). Patients with a history of severe trauma or knee surgery were not included in the study. Demographic and clinical characteristics of the study population are reported in Table I.

Study design

Prior to US assessment all patients underwent a clinical examination by an expert rheumatologist who recorded the presence/absence of pain, tenderness (evoked by palpation and/or active or passive mobilisation of the knee), and knee swelling.

All US examinations were performed by experienced sonographers, one for each centre involved in the study. Patients were asked not to talk about their clinical condition with the sonographers who were blind to both clinical and laboratory data. Sonographers reached a consensus on both the scanning technique to adopt and the pathological findings to report in advance.

US scanning technique

US examinations were performed using a Logiq 9 (General Electric Medical Systems, Milwaukee, WI) equipped with a multifrequency linear probe, working at 9 MHz.

All the knee US examinations were performed using a multiplanar technique adopting the indications provided by the EULAR guidelines for musculoskeletal ultrasound in rheumatology (22). Additional scans, performed to assess a wider cartilage surface, included medial para-patellar views, which were carried out with knee in maximal flexion. The inclination of the US beam was adjusted in order to be perpendicular to the cartilage surface. Dynamic examination during both compression with the probe and flexion-extension of the knee, was carried out to identify the superficial margin of the hyaline cartilage. Lateral and medial longitudinal

views, during flexion-extension of the knee, were the scans adopted to investigate the presence of meniscal calcification. Quadriceps and patellar tendons and entheses were scanned with the patient supine and the lower limbs in extended neutral position. The enthesal thickness was measured at the point of maximal thickness. A detailed description of the scans adopted is reported in Table II.

Setting parameters were standardised as follows:

- grey scale gain was initially set in order to obtain the maximal contrast between the different tissues under examination, and successively reduced at the lowest level allowing the visualisation of only hyperechoic structures using bony cortex as reference;
- pulse repetition frequency of 900 Hz, Doppler frequency of 7.5 MHz and Doppler gain to avoid random noise visualisation.

US image interpretation

Sonographic findings indicative of knee joint inflammation were investigated with knee extended and flexed using the US definitions of synovial fluid and synovial hypertrophy described by the OMERACT special interest group (23). Knee joint effusion was recorded when a minimal amount of anechoic or hypoechoic suprapatellar enlargement was detected. Synovial hypertrophy was recognised by the presence of an abnormally hypoechoic tissue within the joint cavity, different from the more echogenic villous adipose tissue which appears rounded in shape and with clear margins. At hyaline cartilage level, the morphostructural changes used to detect the presence of monosodium urate and of CPPD crystal deposits, were the hyperechoic enhancement of the superficial margin and the hyperechoic spots within the cartilage layer, respectively (9) (Fig. 1A, B). The US identification of meniscal calcification depended on the detection of hyperechoic areas within the meniscal fibrocartilage showing similar echogenicity of the bony cortex even at very low levels of gain (Fig. 1C). Enteseal thickening and intra-tendinous hyperechoic bands with or without acoustic

Table III. Correlation between sonographic and clinical findings indicative of knee joint inflammation.

US findings		Clinical findings		Total
		Presence	Absence	
A. Gout				
Joint effusion	Presence	16	5	21
	Absence	0	39	39
Synovial hypertrophy	Presence	10	0	10
	Absence	6	44	50
Intra-articular power Doppler	Presence	5	0	5
	Absence	11	44	55
<i>Total</i>		16	44	60
B. CPPD disease				
US findings		Clinical findings		Total
		Presence	Absence	
Joint effusion	Presence	35	17	52
	Absence	0	88	88
Synovial hypertrophy	Presence	21	0	21
	Absence	14	105	119
Intra-articular power Doppler	Presence	6	0	6
	Absence	29	105	134
<i>Total</i>		35	105	140

Table IV. Distribution of sonographic findings at different anatomical sites within the knee.

Anatomy	US pathological findings	Gout* Number of knees (%)	CPPD disease* Number of knees (%)
Knee joint	Joint effusion	21 (35)	52 (37.1)
	Synovial hypertrophy	10 (16)	21 (15)
	Intra-articular PD signal	5 (8.3)	6 (4.2)
Hyaline cartilage of the femoral condyles	Enhancement of the superficial margin of the hyaline cartilage	25 (41.6)	1 (0.7)
	Intra-cartilaginous hyperechoic spots	0 (0)	90 (64.2)
Menisci	Meniscal calcification	0 (0)	108 (77.1)
Quadriceps tendon	Hyperechoic spots	3 (5)	8 (5.7)
	Hyperechoic bands without acoustic shadow	1 (1.5)	6 (4.2)
	Hyperechoic bands with acoustic shadow	2 (3.3)	2 (1.4)
	Enteseal thickening	8 (13.3)	11 (7.8)
	Intra-tendinous PD signal	8 (13.3)	7 (5)
Patellar tendon	Hyperechoic spots	2 (3.3)	10 (7.1)
	Hyperechoic bands without acoustic shadow	0 (0)	8 (5.7)
	Hyperechoic bands with acoustic shadow	2 (3.3)	2 (1.4)
	Enteseal thickening	7 (11.6)	13 (9.3)
	Intra-tendinous PD signal	6 (10)	6 (4.2)
Gastrocnemius-semimembranous bursa	Popliteal cyst	1 (1.5)	38 (27.1)

*The percentages have been calculated on a total of 60 and 140 knees for gout and CPPD disease, respectively.

shadowing were the US findings indicative of enthesopathy (Fig. 1D).

Results

Two-hundred knee joints were investigated in a total of 100 patients. Fifty-

one (25.5%) knee joints were found clinically involved, while at least one US finding indicative of joint inflammation was obtained in 73 (36.5%) knee joints. Table III illustrates the relationship between US and clinical findings

indicative of knee joint inflammation. The most frequent US finding indicative of knee joint inflammation was joint effusion, detected in 21 (35%) out of 60 knees and in 52 (37%) out of 140 knees, in gout and CPPD disease, respectively. Ten (17%) out of 60 knees and 21 (15%) out of 140 knees were found positive for synovial hypertrophy with or without intra-articular power Doppler, in gout and CPPD disease respectively. Table IV provides the distribution of US pathological findings obtained according to the different anatomic structures of the knee. Sonographic evidence of crystal deposition within joint cartilage (hyaline and fibrocartilage) was more frequently seen than in the soft tissue in the knee.

Discussion

The role of US in the assessment of patients with crystal-related arthropathies has yet to be firmly established in rheumatological practice and, to date, only few investigators have concentrated on this topic (9-18).

This study demonstrated that US detected a higher number of inflamed knee joints than clinical assessment in patients with crystal-related arthropathies. The low number of knee joints with intra-articular power Doppler signal can be explained by the study design (patients were included independently from the clinical involvement of their knees) and by the limitations related to the technique in the assessment of large joints (the sensitivity of power Doppler in the detection of synovial flow is inversely related to the depth of the synovial tissue).

In conclusion, US signs indicative of knee inflammation were found more sensitive than clinical findings and US evidence of crystal aggregates at cartilage level resulted highly specific allowing for the distinction of characteristic patterns of crystal deposition in patients with gout and CPPD disease

(9-11). While the distribution of crystal deposits at hyaline cartilage level permitted distinction between gout and CPPD disease, further studies are required to investigate both sensitivity and specificity of US features indicative of crystal aggregates at both tendon and enthesal levels.

Link

For further ultrasound images, please go to www.clinexprheumatol.org

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