Monoarticular Crystal Arthropathy of the Knee: Tophaceous Gout

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Keywords

Tophaceous gout · Female patient · High-resolution ultrasonography · Knee joint · Monosodium urate crystals

Abstract

Tophaceous gout is a crystal arthropathy and a disorder of purine metabolism characterized by monosodium urate crystal deposition. A case of tophaceous gout of the knee joint in a 30-year-old female is reported, and the imaging appearances on high-resolution ultrasonography are described. The patient presented with complaints of insidious onset painless swelling of the left knee joint with limitation of range of movement for 1 week. The aspirated joint fluid demonstrated needle-like monosodium urate crystals showing strong negative birefringence consistent with a diagnosis of tophaceous gout. Targeted urate-lowering treatment included oral nonsteroidal anti-inflammatory drugs and oral colchicine. Prophylactic treatment for gout flare-ups included initiation of allopurinol at 300 mg/day along with modification of the dietary regimen including limited consumption of red meat and increased consumption of low-fat dairy products. Symptomatic improvement with reduced pain and swelling of the knee joint was noted at 10 days after treatment. Subsequently, at 3-month follow-up, the patient was disease free with no signs of recurrence and serum uric acid levels at 3.7 mg/dL. In spite of a wide range of therapeutic

options available for the management of tophaceous gout, suboptimal management of gout is prevalent till date in both developing and developed nations across the world.

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Introduction

Tophaceous gout is a type of crystal arthropathy characterized by elevated blood uric acid levels resulting in urate crystal deposition. Gout has a strong male predilection and constitutes the most common cause of inflammatory arthritides affecting males with over 80% of patients having a positive family history [1]. Based on severity, 4 phases of gout have been described in the literature which include chronic gout, acute gout, intercritical gout, and asymptomatic hyperuricemia [2]. Deposition of monosodium urate crystals in joint spaces, cartilage, synovium, and soft tissues triggers inflammatory reaction resulting in musculoskeletal manifestations of gout. Ultrasonography demonstrates extra-articular manifestations of gout, provides guidance for joint fluid aspiration, and is touted to be the preferred diagnostic modality for imaging gout. However, diagnosis is confirmed by analyzing joint aspirate for urate crystals. Monosodium urate crystals are not radio-opaque and appear negatively birefringent on polarized microscopy [3]. Musculoskeletal

Fig. 1. a High-resolution longitudinal ultrasonography image demonstrating a heterogeneous mass-like deposit in the popliteal fossa. Note the focus of calcification (arrow) within. **b** Color Doppler ultrasonography image demonstrating no significant vascularity within the tophaceous deposit. Note the adjacent synovitis and joint effusion (stars).

manifestations of chronic gout include tophi deposition in the synovium and bursae causing synovitis and bursitis, respectively, intratendinous deposition, enthesitis, and punched-out lytic lesions of the bone with overhanging margins.

Case Report

A 30-year-old female presented to the department of orthopedics with complaints of painless swelling of the left knee joint with an insidious onset of progression for 1 month. The patient also complained of limited range of movement of the left knee for 1 week. There was no history of fever or sore throat. The patient gave a history of trauma to the left knee joint about 2–3 years prior which was uneventful. However, there were no ligamentous or meniscal injuries. The patient is overweight with a BMI of 29.2 kg/m². The patient had no comorbidities such as diabetes mellitus or chronic kidney disease and gave no family history of gout or associated rheumatological disorders. The radiographs of the knee joint obtained at that time were normal. Clinical assessment and physical examination revealed a mild joint effusion with signs of inflammation. There was mild synovial hypertrophy, with no features to suggest internal derangement of knee joint. There was no involvement of other joints including hip, ankle, and metatarsophalangeal joints of the foot. The contralateral knee joint also was unremarkable. Subsequently, the patient was referred for ultrasonography for assessment of the knee joint. High-resolution ultrasonography revealed mild left knee joint effusion with evidence of a heterogeneous mass-like deposit in the popliteal fossa demonstrating no significant vascularity on color Doppler examination (shown in Fig. 1a, b). There is associated synovitis and joint effusion. The joint effusion was noted to extend caudally along the fascial planes between semimembranosus and medial head of gastrocnemius tendons approximately 15 cm below the knee joint. There was diffuse subcutaneous edema in the region of the knee

joint extending up to the proximal one-third of the leg. However, deep vein thrombosis was ruled out. Differential diagnosis based on ultrasonography findings included Secondary Baker's cyst with rupture and hemorrhage and tophaceous gout. Blood investigations were unremarkable except for serum uric acid levels which were elevated at 7.6 mg/dL. Subsequently, the joint fluid was aspirated using ultrasonography guidance and sent for cytological examination on polarizing light microscopy which demonstrated needle-like monosodium urate crystals with sharp edges showing strong negative birefringence consistent with a diagnosis of tophaceous gout (shown in Fig. 2). Retrospectively, the patient had elevated blood uric acid levels and treatment initiated with oral non-steroidal anti-inflammatory drugs and oral colchicine. Prophylactic treatment for gout flare-ups included antihyperuricemic agent allopurinol at 300 mg/day. Nonpharmacological treatment included limited consumption of foods high in purine content such as red meat and increased consumption of low-fat dairy products. Pain and swelling of the knee joint subsided in 10 days, and she was able to resume her daily living activities more easily. At 3-month follow-up, the patient was symptom free with no signs of recurrence, and her serum uric acid level was 3.7 mg/dL. The patient has given written informed consent to publish her case and clinical images.

Discussion

Recent studies have explored the role of high-resolution ultrasonography in early diagnosis of gout and for monitoring therapeutic response [4]. Ultrasonography has high diagnostic accuracy in demonstrating tophaceous deposits in joint spaces, synovium, cartilage, and adjacent soft tissues. Deposition of monosodium urate crystals on the most superficial layer of hyaline cartilage

Fig. 2. Polarizing light microscopy image of the knee joint aspirate demonstrating needle-like monosodium urate crystals with sharp edges showing strong negative birefringence consistent with a diagnosis of tophaceous gout.

results in “double contour sign” which is an irregular echogenic line demonstrated on ultrasonography and notably manifests during gout flare-up in patients with a prior history of gout attacks, and with asymptomatic hyperuricemia [5]. However, the sensitivity of these findings on ultrasonography ranges between 25% and 95% [6].

On ultrasonography, synovitis has a mixed echogenicity with increased vascularity in patients with gouty arthritis. Unlike the frond-like appearance of the synovium noted in rheumatoid arthritis, synovial hypertrophy in gout appears more concentric. “Snow storm appearance” on ultrasonography is the result of floating hyperechoic foci in the joint effusion, likely representing microtophi. Ultrasonography has high specificity in demonstrating intratendinous tophi deposition and in diagnosing bursitis and enthesitis in patients with gout [7]. Although a nonspecific finding, joint effusion has been reported to be the earliest sign in gouty arthritis [8]. Ultrasonography also demonstrates extra-articular manifestations of gout, provides guidance for joint fluid aspiration, and is touted to be the preferred diagnostic modality for imaging gout. However, ultrasonography may not be a reliable imaging modality for diagnosing intraosseous gout [9]. While it is true that ultrasonography is more sensitive than radiographs for diagnosing bony erosions of gouty arthritis, caution must be exercised as ultrasonography may underestimate the number and extent of erosions when

compared to magnetic resonance imaging. Nevertheless, the presence of tophaceous deposits and adjacent synovitis increases the specificity of diagnosing bone erosions on ultrasonography [10]. Ultrasonography may also assist in diagnosing atypical presentation of tophaceous gout, including assessment of therapeutic response.

Ultrasonography can reliably demonstrate intratendinous and intra-articular microcrystal hyperechoic aggregates which play a key role in the pathogenesis of tophaceous gout. Applications of ultrasonography in tophaceous gout relate to monitoring disease progression and structural modifications secondary to microcrystal deposition. There have been reports suggesting excellent correlation between lowering uric acid levels and diminishing imaging signs on ultrasonography at 6 months in responders of treatment [11]. Ultrasonography has good sensitivity and specificity for the diagnosis of tophaceous gout which is further dependent on site of joint involvement, severity, and duration of the disease [12]. Recently, advanced imaging techniques such as dual-energy computed tomography have demonstrated microcrystal deposition of tophaceous gout within the synovium of joint spaces and bony surfaces with evidence of a cortical break [13]. Nevertheless, the significance of positive early imaging findings in patients with asymptomatic hyperuricemia is still to be determined.

Management of gout is broadly classified based on the treatment of acute gout attacks and prevention of gouty flares. The American College of Rheumatology (ACR) recommends dietary modification and urate-lowering agent allopurinol initiated at 100 mg daily for patients with tophaceous gout [14]. The European League Against Rheumatism (EULAR) guidelines recommend allopurinol as the first-line urate-lowering agent. However, febuxostat is recommended as an alternative for patients with renal failure and decreased renal creatinine clearance [15]. Hyperuricemia is alone not sufficient for the diagnosis of gout. The diagnostic criteria for gout include a combination of key clinical signs, laboratory investigations, and imaging findings. Nevertheless, evidence of a tophaceous deposit or aspirated urate crystals from the joint fluid is the major diagnostic criterion for initiation of urate-lowering therapy. Recent studies have estimated an 18% reduction in the serum uric acid levels with non-pharmacological treatment such as modification of the dietary regimen alone [16]. Paradoxically, gouty flares coincide with the onset of urate-lowering treatment to decrease serum uric acid levels. While the mechanism behind this phenomenon is not fully understood, theories that were put forward suggest activation of previously

precipitated crystals to be the likely cause for these flares which may be the reason behind nonadherence to drug therapy within the first year of treatment initiation in approximately 56% of patients [17].

Conclusion

This case report describes the high-resolution ultrasonography appearances of tophaceous gout of the knee joint and stresses on the fact that the entity needs to be included in the differential diagnosis of unilateral joint swelling. Ultrasonography can reliably demonstrate intra-articular and intratendinous microcrystal deposition. In tophaceous gout, ultrasonography may assist in the evaluation of extra-articular involvement and in providing guidance for joint fluid aspiration. Hyperuricemia is alone not sufficient for the diagnosis of gout, and management options are aimed at treatment of acute gout attacks and prophylaxis of gouty flares, with allopurinol being the key urate-lowering agent. In conclusion, this case report deserves special mention, as the index case described is a female patient with no significant family history, and literature review suggests a strong male predilection of 20:1 with strong familial predisposition. Tophaceous gout can mimic conditions such as septic arthritis or neoplasm which incorporate a completely different management approach. Also, atypical presentation of tophaceous gout can sometimes be misdiagnosed as internal derangement of the knee which may warrant unnecessary arthroscopy procedures. Discrete pattern of comorbidities in patients with gouty arthritis with poor dietary intervention and nonadherence to treatment regimen makes a significant contribution to the ever-increasing burden of the disease from nations across the world.

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Statement of Ethics

Ethical approval to report this study was obtained from the Institutional Ethics Committee (IEC), St. John's Hospital (Ethics Committee Registration No. SJH/089/2021). The author certifies that all appropriate patient consent forms were obtained. In the form, the patient has given her consent for the images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published, and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

Conflict of Interest Statement

There are no conflicts of interest.

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Data Availability Statement

All data or images generated during this case report are included in this article. Further enquiries can be directed to the corresponding author.

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