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CASE REPORT

Dual-energy Computed Tomography for Diagnosis of Gouty Tophus of Tibia with Pathological Fracture Simulating Malignancy

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ABSTRACT

Gouty tophus with pathological fracture is rare and can mimic infection and malignancy. We report the first case of intra-osseous tophus of the tibia complicated by pathological fracture. Although rare, intra-osseous gouty tophus can present with pathological fracture and thus should always be considered in the presence of collateral evidence. Dual-energy computed tomography (DECT) is highly accurate in detecting intra-articular and peri-articular monosodium urate in gout. In our patient, DECT clearly depicted both intra-articular and peri-articular monosodium urate depositions. Nonetheless, this imaging technique is not without pitfalls. As illustrated in our patient, the intra-osseous component is wrongly shown as being monosodium urate free. We postulate that the intra-osseous location may be a potential pitfall of DECT. Radiologists and clinicians should keep this in mind during image interpretation.

Key Words: *Fractures, spontaneous; Gout; Radiography, dual-energy scanned projection*

中文摘要

雙能量電腦斷層掃描診斷類似惡性腫瘤病理性骨折的脛骨痛風石病

陳彥豪、曾慧勤、黎國忠、陳文光

有病理性骨折的痛風石病罕見，可以類似感染和惡性腫瘤表現。我們報告首例脛骨骨內痛風石伴有病理性骨折。骨內痛風呈現病理性骨折雖罕見，但有附帶證據時仍應考慮。雙能量電腦斷層掃描（DECT）能準確地檢測痛風中的關節內和周圍的尿酸鈉。在我們的患者中，DECT清楚地描繪了關節內和周圍的尿酸鈉沉積。然而這種成像技術不是沒有缺陷。如本患者所示，其骨內組織錯誤地顯示為不含尿酸鈉。這可能是DECT的潛在缺陷。放射科醫生和臨床醫生在解讀圖像時應記住這一點。

INTRODUCTION

Gouty arthritis is the most common form of inflammatory arthritis in both men and women.[1] Typically, it manifests radiographically as dense peri-articular soft tissue, juxta-articular erosions with overhanging edges, with joint space and bone density preserved. Pathological fracture is rare, with only 16 cases found in the literature.[2-6] We report the first case

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of gouty tophus of tibia complicated by pathological fracture. We also discuss the application of dual-energy computed tomography (DECT) in the diagnosis of this disease entity.

CASE REPORT

In May 2015, a 43-year-old man presented to our accident and emergency department with a 1-week history of left leg pain. He was able to walk with mild difficulty. He was an alcoholic with a history of gout. His body temperature was 39ºC. Blood pressure and pulse rate were normal. White cell count was elevated (13.1 $x10^9$/l). Serum urate level was normal (0.49 mmol/l). Plain radiographs revealed an ill-defined osteolytic lesion with a wide zone of transition in the proximal meta-diaphysis of the tibia (Figure 1). It was associated with an extra-osseous soft tissue mass and a pathological fracture through the lateral cortex. No matrix calcification was demonstrated. Computed tomography (CT) and bone scan were arranged for workup of the provisional diagnosis of acute osteomyelitis. CT confirmed the presence of an intramedullary lesion as well as a well-circumscribed extra-osseous soft tissue mass, periosteal new bone formation and pathological fracture (Figure 2). In addition, intra-articular and peri-articular calcifications along the cruciate ligaments, collateral ligaments, quadriceps tendon, and medial gastrocnemius tendon were shown. Similar but milder intra-articular and peri-articular calcifications were present at the right knee. Peri-articular calcified masses with erosions of the left mid-foot joints, preservation of joint spaces and bone density were also noticed. Bone scan showed an increased uptake in perfusion, blood pool and delayed phases in the left proximal tibia, corresponding to the index lesion shown in CT (Figure 3). Increased uptake was also seen in both shoulders, elbows, wrists, knees, ankles, and mid-foot joints, in keeping with polyarthritis. At that juncture, the proximal tibial lesion was suspected to be either an aggressive bone tumour or intra-osseous tophus; other findings were compatible with chronic tophaceous gout. Ultrasonography-guided biopsy of the soft tissue component of the left proximal tibial lesion yielded chalky whitish material. Positive birefringent monosodium urate (MSU) crystals were seen on microscopic examination, confirming a gouty tophus. As the possibility of the intramedullary lesion being malignant could not be excluded, DECT was performed to confirm the diagnosis. In our centre, DECT was performed with 128-slice CT (SOMATOM Definition Flash, Siemens Healthcare) at 80 kV and 140 kV. MSU crystals were shown as green pixels with vendor-specific post-processing software. In our patient, MSU crystals were depicted in the extra-osseous soft tissue component of the proximal tibial lesion, as well as in bilateral shoulders and knees. However, there was no MSU demonstrated in the intramedullary tibial lesion (Figure 4). CT-guided biopsy of the intramedullary lesion again yielded chalky whitish material, and MSU crystals were identified histologically. The diagnosis of intra-osseous gouty tophus was ascertained. The patient then underwent close reduction internal fixation of the fracture, and intensive medical treatment for gout.

DISCUSSION

Typical radiographic findings of gout include dense peri-articular soft tissue swelling, juxta-articular

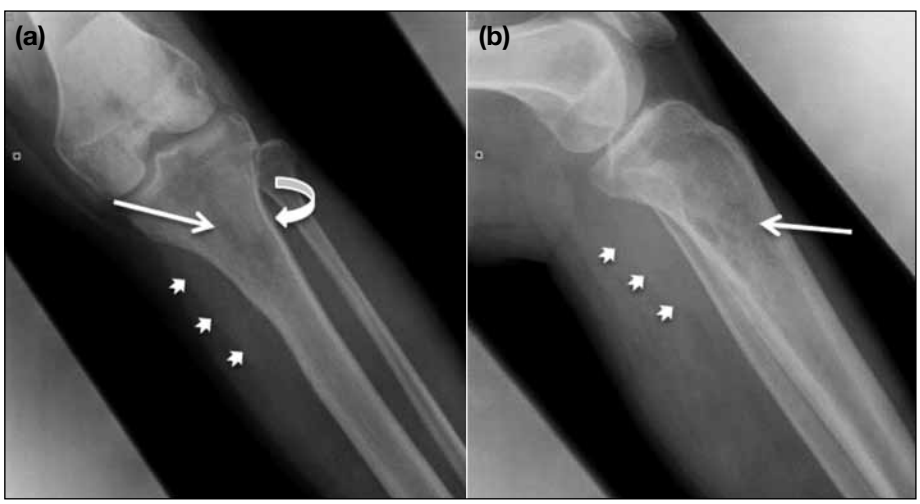

Figure 1. (a) Frontal and (b) lateral radiographs of left leg: a large ill-defined osteolytic lesion with wide zone of transition (arrow) is noted in the proximal meta-diaphysis of the left tibia. Extra-osseous soft tissue mass (arrowheads) and pathological fracture (curved arrow) are identified. No periosteal reaction or matrix calcification is demonstrated.

Figure 2. (a) Soft tissue and (b) bone windows of axial contrast-enhanced computed tomography (CT) at the proximal tibia level: heterogeneous soft tissue mass (arrows) in the intramedullary tibia and adjacent soft tissue, with features of cortical disruption, periosteal new bone formation, and pathological fracture (curved arrow) that represent aggressive bone lesion. (c) Axial bone window and (d) sagittal soft tissue window contrast-enhanced CT: multiple peri-articular calcified masses with erosions in left mid-foot joints (arrowhead) with joint spaces and peri-articular bone density relatively preserved. Intra-articular and peri-articular calcifications along the cruciate ligaments (arrowheads) are also seen in knee joint.

erosions with overhanging edges, and preservation of joint space and bone density. Pathological fracture is very rare, and when it happens it mimics a bone tumour or tumour-like lesions. Only 16 cases of pathological fracture of gouty tophus are reported in the literature, most of which occurred in the patella (nine patients). Other reported sites of involvement include the cervical spine, pelvic bone, femoral neck, and short bones of the hand and foot. To the best of our knowledge, this is the first reported case of intra-osseous gouty tophus in the tibia complicated by pathological fracture. Nonetheless, pathological fracture does occur in intra-osseous gout and should always be considered when other collateral evidence of tophaceous gout is present.

DECT is non-invasive, highly sensitive and specific for the diagnosis of gouty arthritis in patients with joint pain or swelling.[7-10] A meta-analysis of three studies investigating the intra-articular and peri-articular soft tissue structures concludes that the pooled sensitivity and specificity are 0.87 (0.79-0.93) and 0.84 (0.75-0.9), respectively.[7] No study has validated the result in the subgroup of intra-osseous tophus.

In our patient, MSU deposits were clearly depicted in intra-articular and peri-articular structures of multiple joints. Our experience further substantiates the results from the literature. Nonetheless, the histology-proven MSU in the intramedullary tophus could not be demonstrated on DECT. We postulate that intra-osseous location may be a pitfall of DECT leading to false negativity. Tissue characterisation by DECT is

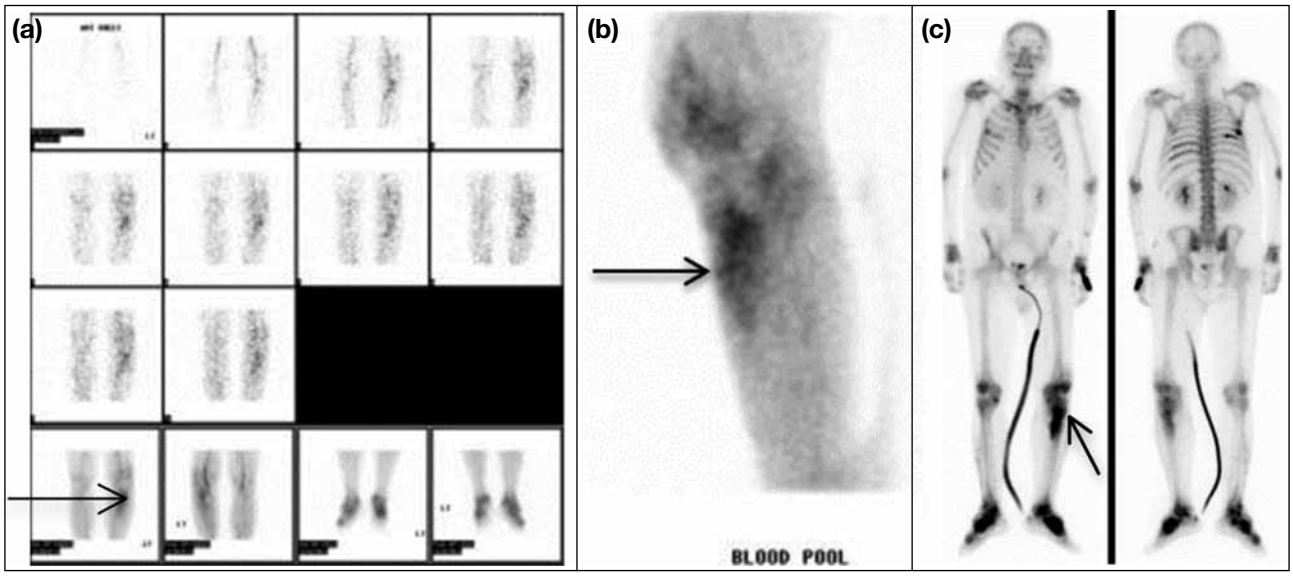

Figure 3. (a) Perfusion, (b) blood pool, and (c) delay phase of bone scans: increased perfusion, blood pool, and delay phase uptake in the left proximal tibia (arrows) corresponding to the index mass detected in radiographs and computed tomography. Symmetrical increased uptake in bilateral shoulders, elbows, wrists, knees, ankles, and mid-foot joints is compatible with polyarthritis.

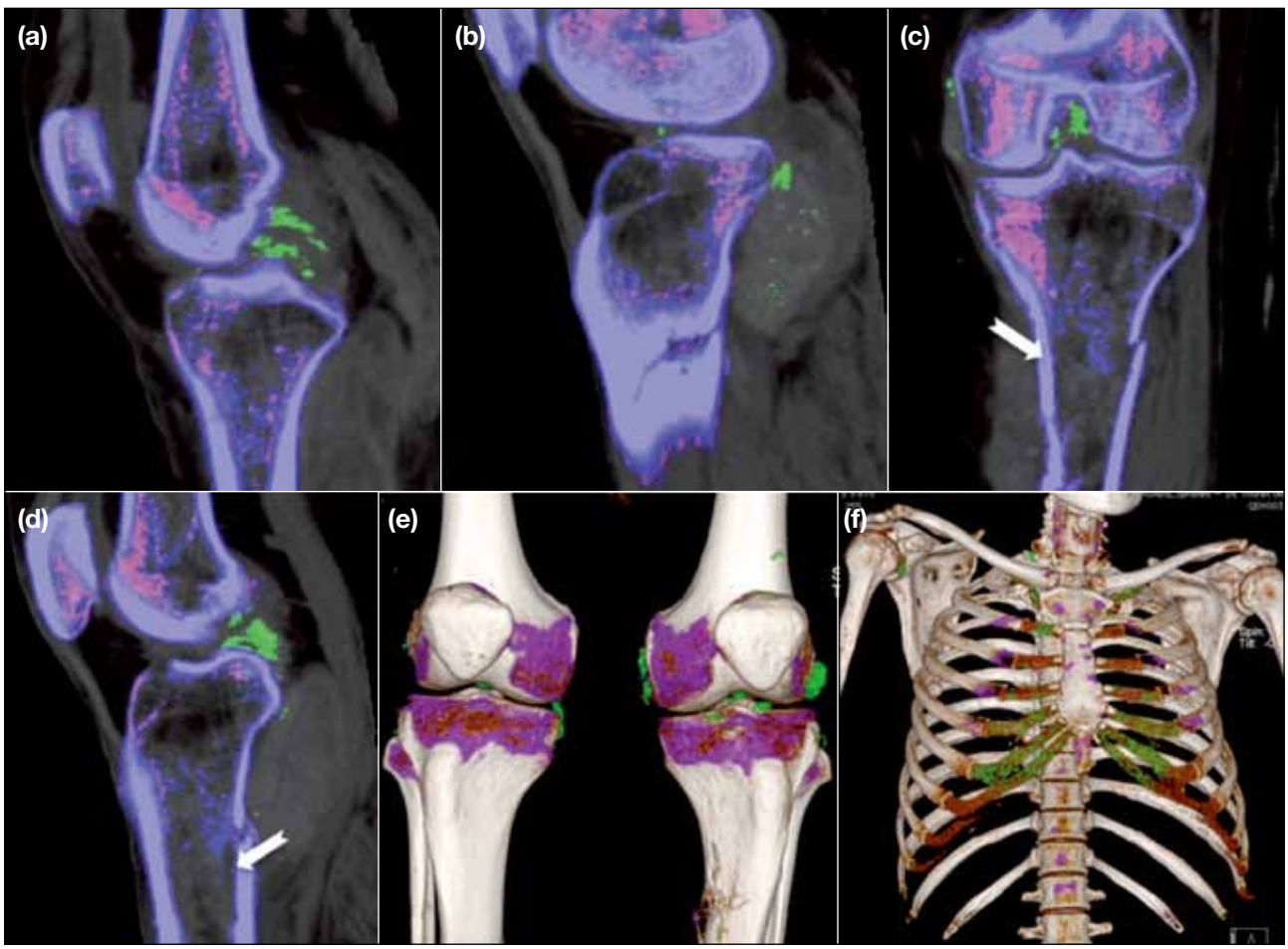

Figure 4. (a-d) Dual-energy computed tomography and (e, f) 3D-reformat images: green pixels suggestive of monosodium urate (MSU) crystals are seen in the intra-articular and peri-articular soft tissue of both knees, shoulders, ribcage and the extra-osseous component of the left proximal tibial lesion, diagnostic of gout. Note that no MSU deposition is shown in the intramedullary left tibial lesion (arrows).

based on the ratio of CT value at two different tube voltages.[11] Uric acid has a slightly negative dual-energy index, meaning the CT value at 80 kV is slightly lower than that at 140 kV. On the contrary, calcium has a much higher dual-energy index; CT value at 80 kV is much higher than that at 140 kV, thus allowing differentiation between them. When there is abundant background calcium, for instance in the trabecular bone in our patient, the drop in CT value of uric acid may be cancelled out by the rise in CT value of calcium within the same voxel, resulting in a false-negative result. Radiologists and clinicians should bear this in mind during interpretation of DECT, although this postulation has to be confirmed with larger-scale studies.

CONCLUSION

Intra-osseous gout complicated by pathological fracture can mimic malignancy. Although DECT is highly accurate in detecting both intra-articular and peri-articular gouty tophus, it has potential pitfalls in the diagnosis of intra-osseous gout.

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