

CT and MRI findings in gouty arthritis involving large joints of the upper extremities

Yang Yuling

Zhongshan Hospital of Traditional Chinese Medicine

Guo Yongfei

Zhongshan Hospital of Traditional Chinese Medicine

Yu Shuiquan

Zhongshan Hospital of Traditional Chinese Medicine

Bin Zou (✉ 251942085@qq.com)

Zhongshan Hospital of Traditional Chinese Medicine

Research Article

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Abstract

Background

Gouty arthritis is a type of metabolic disease in which sodium urate crystals are deposited in the bone and joints, causing local inflammatory reactions and destruction of the bone tissue. Gouty arthritis involving the large joints of the upper extremities is rare in clinical practice. This study aimed to analyze the computed tomography (CT) and magnetic resonance imaging (MRI) findings of gouty arthritis primarily involving the large joints of the upper limbs, signal or density characteristics of the tophi, growth patterns, involvement of the adjacent joints, and differentiation from other lesions occurring in this area and to discuss the causes of misdiagnosis.

Methods

CT and MRI data were collected from 14 patients with gouty arthritis, primarily involving the shoulder and elbow joints, and their imaging features were analyzed.

Results

14 patients were aged between 28 and 85 years, All patients demonstrated nodular or mass-like abnormal signal shadows on CT, with equal or slightly long signals on T1-weighted image (WI) and short or slightly long signals on T2WI in the MRI. All 14 patients revealed narrowing of the affected joint space, with bone resorption and erosion under the joint surface of the larger tophi. The tophi grew around the joint, with anterolateral and posterolateral tophi observed predominantly in the shoulder joint, and dorsal tophi observed predominantly in the elbow joint on the MRI, with compression and edema of the surrounding soft tissues.

Conclusions

We analyzed patients with gouty arthritis involving the large joints of the upper extremities and observed an increased prevalence in young and middle-aged men who may have had clear tophi in the past.

Introduction

Gout is a form of rheumatic metabolic disease in which hyperuricemia occurs with urate deposition, leading to gouty arthritis, uric acid nephropathy, and kidney stones. The incidence of gout is gradually increasing in China[1] which tends to be lower in several regions of the world, with a relatively high incidence in individuals from the coastal or economically developed areas, which is believed to be related[2–4] to the changes in dietary structure. It is clinically divided into acute, intermittent, and chronic gouty stone phases. Gouty arthritis is a type of metabolic disease in which sodium urate crystals are

deposited in the bone and joints due to the supersaturation of uric acid in the blood, causing local inflammatory reactions and destruction of the bone tissue. Gouty stone formation is the pathological basis of gouty arthritis, usually characterized by nodular tophi, mostly involving the ankle, knee, and other extremity joints, and most often involving the intercuneiform joints, with bone resorption and erosion under the joint surface and narrowing of the joint space. Gouty arthritis involving large joints of the upper extremities is rare in clinical practice. In this study, we collected 14 cases of gouty arthritis involving the elbow and shoulder joints of the upper extremities that were clinically or pathologically diagnosed in our hospital, compiled their clinical and imaging data, analyzed their imaging manifestations, and discussed the causes of misdiagnosis and how to differentiate them from other lesions.

Methods

Patients

General data: A total of 14 patients with gouty arthritis involving the large joints of the upper extremities were admitted to the hospital for a period of 4 months from 2014–2021. Informed consent from the patients was waived due to the retrospective nature of the study. All patients were males, with an age range of 28–85 years. Out of the 14 patients, 7 underwent computed tomography (CT), and 7 underwent magnetic resonance imaging (MRI). Among the eight patients with gout in their elbow joint, six underwent MRI, and two underwent CT; among the six patients with gout in their shoulder joint, only one underwent an MRI, and five underwent CT.

Data Collection

CT or MRI data and clinical data, including the uric acid levels, pathological findings, and past medical history, were collected from all patients to confirm whether they had gout. (Table 1).

Scanning Method

MRI examination: Siemens 1.5T MR imager with a small joint array coil was used. The MR scan sequence included sagittal T2-weighted image (WI), T1WI fat suppression of the spine, and axial T2WI (T1WI: TR 300 ms and TE 4 ms; T2WI: TR 1200 ms and TE 84 ms; axial FOV, 139 mm×139 mm; matrix, 512×512; layer thickness, 4 mm; layer spacing, 5 mm).

CT examination: GE 16-row spiral CT or Siemens 64-row 128-layer spiral CT was used for the imaging with a layer thickness and spacing of 2 mm. After completing the scan, the original images were post-processed. Multiplanar reformation coronal and sagittal reconstructions were performed, and the reconstructed layer thickness and spacing were 2 mm.

Imaging Studies

All images were analyzed by two diagnostic imaging physicians with more than 10 years of clinical experience. Specific imaging evaluation indicators included the site of gouty arthritis, gouty stone growth

size, morphology, density, or signal characteristics, as well as subsurface bone changes, whether the joint space was narrowed, and surrounding soft tissue conditions.

Results

All patients were confirmed to have gout based on the clinical, pathologic, radiographic, or laboratory examination; all patients underwent either CT or MRI. The results of blood uric acid were from 303 to 688. This group of cases showed that there was no positive correlation between uric acid and the size of tophi (Table 1).

Table 1

| Sex | Age | blood uric acid level | Location | Diagnostic method | Image examination method |
|-----|-----|-----------------------|-----------------------|--|--------------------------|
| M | 63 | 503 | Left shoulder joint | Surgical pathology | MR |
| M | 28 | 587 | left elbow | Surgical pathology | MR |
| M | 55 | 591 | Right elbow | Surgical pathology | MR |
| M | 55 | 591 | Right elbow | Surgical pathology | CT |
| M | 51 | 519 | left elbow | Surgical pathology | CT |
| M | 44 | 666 | Right shoulder joint | Surgical pathology | CT |
| M | 66 | 711 | Right elbow | Surgical pathology | MR |
| M | 51 | 562 | left elbow | Surgical pathology | MR |
| M | 47 | 621 | left elbow | Surgical pathology | MR |
| M | 56 | 587 | Right elbow | Surgical pathology | MR |
| M | 45 | 630 | Double shoulder joint | Years of gout history + gouty arthritis in other parts | CT |
| M | 63 | 688 | Double shoulder joint | Years of gout history + gouty arthritis in other parts | CT |
| M | 85 | 303 | Double shoulder joint | Years of gout history + gouty arthritis in other parts | CT |
| M | 49 | 567 | Double shoulder joint | Years of gout history + gouty arthritis in other parts | CT |

CT or MRI directly demonstrated tophi deposition. The seven patients with tophi who underwent CT showed slightly high-density masses or clumps of different sizes, with different degrees of narrowing of the adjacent joint space, accompanied by varying degrees of bone erosion under the joint surface, and some of the larger tophi were mass-like, compressing the adjacent soft tissues. The seven patients who underwent MRI showed nodular or mass-like abnormal signal shadows, with equal or slightly long signals on T1WI and short or slightly long signals on T2WI, varying in size and morphology, and some of the larger tophi had mixed signals on T1WI and T2WI. All 14 patients revealed narrowing of the affected

joint space and different degrees of bone resorption and erosion under the joint surface. Tophi grew around the joint, and they were predominantly observed on the anterior and lateral sides in the shoulder joint and on the dorsal side in the elbow joint. Compression and edema of the surrounding soft tissues were observed on the MRI.

Discussion

Clinical features and pathological basis

Gouty arthritis most commonly affects the joints of the extremities, including the joints of the first toe, metatarsal, intercuneiform, ankle, knee, wrist, and elbow. It often affects the joints unilaterally and predominantly occurs as osteoarthritic lesions, with uric acid deposition in the joints or bursae as the pathological basis, leading to the inflammation of the surrounding soft tissues and slow erosion of the bone surface, resulting in bone resorption and destruction from the outside to the inside. Patients with gouty arthritis usually experience joint pain and limited movement in the corresponding area due to joint inflammation and bone marrow edema. It has been suggested that gouty arthritis occurring in the spine may be associated with hypertension, obesity, impaired renal function, or poorly controlled hyperuricemia[5–8].

Imaging Features

Gouty arthritis involving large joints of upper limbs is very rare, and only a few related cases have been reported clinically[9–11]. There are few manuscripts on the imaging analysis of gouty arthritis of elbow and shoulder. In our study, we collected the clinical, laboratory, and radiographic information of gouty arthritis involving the elbow and shoulder joints, which demonstrated bone resorption and erosion under the joint surface, accompanied by high-density or iso-T1, slightly longer T2, and gouty stone formation around the joints. The data showed that there was no positive correlation between the size of tophi and the value of blood uric acid.

Some cases of our study occurred in the elbow joint were misdiagnosed as tumor lesions due to the formation of soft tissue masses and erosion of the adjacent bones. Patients with gouty arthritis occurring in the shoulder joint had tophi deposited in and around the joint space, involving the tendons around the shoulder joint or causing narrowing of the joint space, resulting in movement restriction of the shoulder joint, and other symptoms extremely similar to those of frozen shoulder. These symptoms are very similar to those of a frozen shoulder, such as limitation of the shoulder movement, which leads to incorrect diagnosis at the initial consultation. Moreover, regardless of whether the shoulder or elbow joint is involved, when the joint surface is inflamed, the patient experiences pain in the corresponding area.

Analysis of the causes of misdiagnosis

Among the 14 patients in this study, only 6 were accurately diagnosed after the first imaging examination, namely, 5 patients who underwent a CT scan of the shoulder joint and 1 who underwent an MRI of the elbow joint with a clear tophi; the remaining 8 patients were misdiagnosed. The reasons for

misdiagnoses were analyzed, among which three patients who underwent an MRI of the elbow joint were considered to have large tophi at the first examination site, where the MRI demonstrated a huge mass with mixed signals, extensive edema of the surrounding soft tissues, and bony involvement of the adjacent joints. However (Figure 2a-c), the postoperative retrospective analysis revealed that the soft tissues around the tophi showed extensive edema, but the edema applied pressure only without any obvious signs of soft tissue invasion. The remaining five patients were diagnosed with synovial inflammation of the joints only. Misdiagnosis occurred due to the small size of the tophi, and the patients reported no clear previous history of gout; therefore, the possibility of this disease was not fully considered at the initial diagnosis. However, the postoperative retrospective analysis demonstrated powder lines, involved joints around the tophi with slight bone resorption, and narrowing of the joint space, which, combined with specific laboratory tests, could be consistent with gouty arthritic changes.

Differential diagnosis

The following differential diagnoses can be considered for patients demonstrating the signs and symptoms of gouty arthritis:

1. Traumatic arthritis: Patients with traumatic arthritis usually have a clear history of trauma. The lesion can be observed months or years after the trauma, which presents with narrowing of the injured joint space, accompanied by the formation of a bony flap at the edge of the joint, with a higher density in the flap than the tophi, and a more lamellar rather than mass-like morphology, which may be surrounded by free body formation, with or without joint space and cartilage damage.
2. Ossifying myositis: The early stage of ossifying myositis is the stage of trauma and inflammatory reaction, often manifesting as significant muscle, fascia, and tendon edema without an exact mass. The middle stage is the most difficult to diagnose, and the typical imaging manifestation is the reduction of edema of the lesion on CT and MRI, with progressively clearer borders and signs of stratification. In the late stage, with the advancement of calcification and ossification, the lesion tends to be completely ossified, the edema around the lesion disappears, the boundary is clear, and the lesion appears as a strip or irregular shaped calcified foci and bone masses, and the CT shows irregular shaped or strip-shaped high-density bone masses, and the MRI shows iso-T1WI and iso-T2WI signal changes, and the signal is the same as that of the adjacent bone; there are no signs of erosion of the surrounding muscles and soft tissues; the lesion is often not connected to the adjacent bone. The lesion is often not connected to the adjacent bone, and there is no destruction of the adjacent bone or periosteal reaction.
3. Frozen shoulder: Frozen shoulder usually occurs in middle-aged and elderly patients, usually with degenerative degeneration of the shoulder joint. Frozen shoulder is caused by vasoproliferative synovitis of the joint capsule, followed by leakage of fluid, inflammatory factors and proteins from the joint cavity, causing fibrosis, scar formation and thickening of the joint capsule and other soft tissue structures. and images show thickening and edema of the joint capsule, followed by a smaller joint cavity, which is distinct from gouty arthritis, which is characterized by fluid accumulation in the

joint capsule and deposits of urate crystals in the joint cavity or in the periarticular tissues, causing an inflammatory response. We can diagnosis if the image shows the tophi.

Treatment methods

Medication such as colchicine is the primary treatment for patients with gouty arthritis involving large joints in the upper extremities to reduce uric acid concentrations combined with dietary intervention[13]. However, some patients may be admitted to the hospital with no obvious symptoms and only with swelling around the joint, which requires imaging combined with laboratory tests to arrive at an accurate diagnosis and provide targeted interventions to prevent possible future symptoms[14–19]. To avoid more serious bone destruction of the joints caused by tophi deposition, a surgery such as arthrotomy and aspiration, lesion removal, and even joint replacement may be planned according to the patient's condition[13].

Conclusions

The clinical manifestations of gouty arthritis involving the large joints of the upper extremities are not characteristic; it primarily manifests as pain in the joint extremities caused by joint inflammation at the involved sites; however, the imaging findings have certain characteristics. In this group of cases involving gouty arthritis of the upper extremities, when the elbow and shoulder joints are involved, there is an accumulation of fluid in the surrounding joint capsule with gouty stone formation. These stones were usually large in size at the time of diagnosis and were associated with subsurface bone resorption and erosion with or without cartilage destruction. When large tophi are formed, they occur in combination with surrounding soft tissue and bone erosion and must be distinguished from tophi of soft tissue origin. In this study, we collected data on gouty arthritis occurring in large joints of the upper extremities, analyzed their imaging features, and proposed differentiation points with traumatic arthritis and ossifying myositis, especially for cases occurring in the shoulder joint, and proposed imaging features for differentiation with frozen shoulder. However, the number of patients in this study is small, and more information is needed to explore the imaging patterns. There is a lack of imaging data for gouty arthritis involving the wrist joint, which needs to be supplemented by collecting more empirical data in the future. However, when we fully understand the above features, combined with the differential diagnosis of gouty arthritis, we can strive to improve the accuracy of imaging diagnosis, provide clinical advice and early treatment, and avoid serious consequences caused by delayed treatment.

Abbreviations

CT- computed tomography

MRI- magnetic resonance imaging

WI- weighted image

Declarations

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None

Ethics approval and consent to participate

As the retrospective nature of the study, patient consent was waived.

Consent for publication

Not applicable

Availability of data and materials

All the data were uploaded and saved to our hospital. If necessary, please contact the corresponding author for access to the data.

Competing interests

All authors have no conflicts of interest to disclose.

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Authors' contributions

YL Yang and B Zou contributed to the conception and design of the study, Conceptualization, Methodology, Data curation. YL Yang wrote the manuscript. SQ Yu supervised the research. YF Guo collected the data. All authors contributed to the critical revision of the manuscript.

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None

Author's information

Yuling Yang, department of Radiology, Zhongshan Hospital of Traditional Chinese Medicine Affiliated With Guangzhou University of Chinese Medicine. Zhongshan, 528400, P. R. China.

Yongfei Guo, department of Radiology, Zhongshan Hospital of Traditional Chinese Medicine Affiliated With Guangzhou University of Chinese Medicine. Zhongshan, 528400, P. R. China.

Shuiquan Yu, department of Radiology,Zhongshan Hospital of Traditional Chinese Medicine Affiliated With Guangzhou University of Chinese Medicine.Zhongshan, 528400, P. R. China.

Bin Zou, department of Ultrasonography,Zhongshan Hospital of Traditional Chinese Medicine Affiliated With Guangzhou University of Chinese Medicine.Zhongshan, 528400, P. R. China.

Corresponding author:

Bin Zou, department of Ultrasonography,Zhongshan Hospital of Traditional Chinese Medicine Affiliated With Guangzhou University of Chinese Medicine.Zhongshan, 528400, P. R. China.

E-mail address: 251942085@qq.com Tel+86 13923336069

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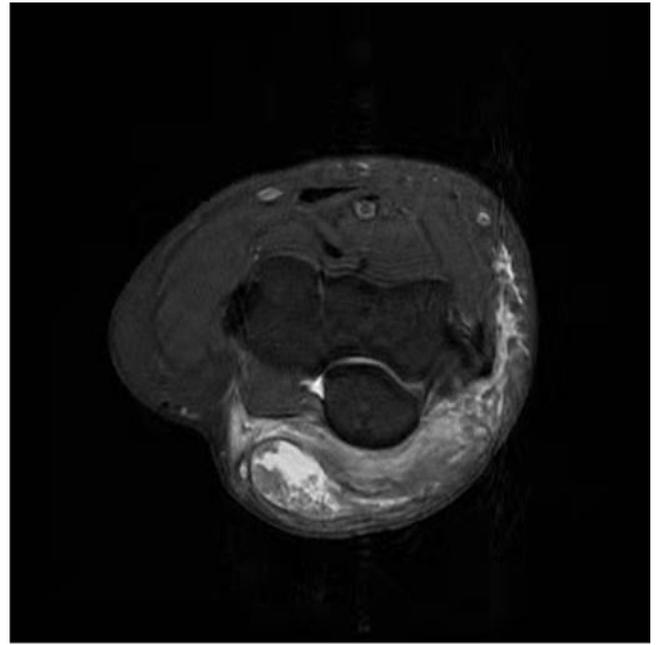
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Figures



A



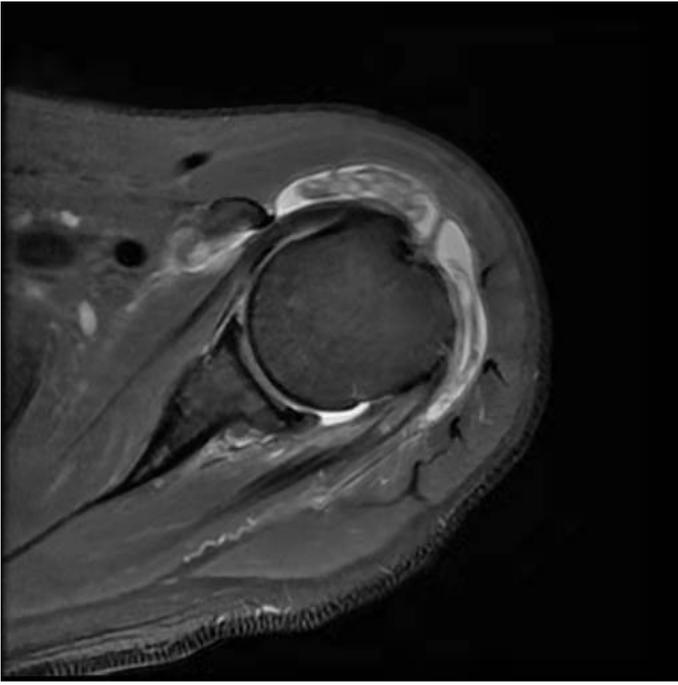
B



C

Figure 1

shows high-density urate masses around the joints or appearing as mass-like, with equal/slightly long T1 and short/slightly long T2



A



B



C

Figure 2

shows the MRI demonstrated a huge mass with mixed signals, extensive edema of the surrounding soft tissues.