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Gouty tophus of the patella evaluated by PET imaging

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Abstract We report a case of gouty tophus of the patella, a rare lesion, which was evaluated using positron emission tomography (PET). This modality, which uses a combination of an amino-acid analog emitter, L-[3-^{18}F]-alpha-methyl tyrosine (FMT), which neglects malignancies, and a glucose analog emitter, ^{18}F-fluoro-2-deoxy-D-glucose (FDG), which neglects benign lesions, simulating the radiographic findings, may be useful for the preoperative evaluation of gouty tophus occurring in patella partita, including detection, differentiation from malignant tumors, and possible pathogenetic diagnosis.

Key words Gout · Patella · PET · FDG · FMT

Introduction

Gouty tophus is often found in the auricular cartilage or in the big toe, but rarely in the patella;[2] when this lesion does occur in the patella, it is likely to be misdiagnosed as bone tumor even when a variety of imaging modalities are used. In recent years, positron emission tomography (PET) imaging, utilizing ^{18}F-fluoro-2-deoxy-D-glucose (FDG) and L-[3-^{18}F]-alpha-methyl tyrosine (FMT) has been reported to be useful for the evaluation of musculoskeletal tumors, including detection, differentiation of malignant tumors from benign lesions, and noninvasive grading.[9,10] To our knowledge, the gouty tophus in the patella that we report here is the first reported case in which gouty tophus (in particular, in the patella) was correctly evaluated by PET imaging; we discuss the diagnostic role of PET imaging in gouty inflammation.

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Case report

A 53-year-old man complained of right knee pain, without any traumatic episode, on January 31, 1999. The pain gradually worsened, and he consulted our hospital on February 9. At the first consultation, it appeared that the pain affected his gait, and he limped. Physical examination revealed a bony protrusion on the superiolateral side of the right patella, with tenderness, local heat, and localized redness in the overlying skin. There was a marked difference in the girth of the right (46.5 cm) and left (50.0 cm) thighs, indicating muscle atrophy of the right thigh. The range of motion (ROM) in his right knee from 0° to 90° was restricted by pain. Laboratory findings showed elevated levels of C-reactive protein (0.6 mg/dl; normal range, <0.1 mg/dl) and serum uric acid (9.4 mg/dl; normal range, 3.2–8.1 mg/dl). White blood cell count was 8600/mm^3, which was within the normal range.

Plain radiograph revealed a cystic lesion on the lateral side of the right patella, surrounded by a slightly sclerotic rim (Fig. 1). Computed tomography (CT) confirmed the radiographic findings and showed irregular high-density spotty areas in the surrounding soft tissue (Fig. 2). T1-weighted magnetic resonance imaging (MRI) showed an intraosseous lesion that was iso-intense in relation to the synovium (Fig. 3a), with heterogeneous gadolinium enhancement (Fig. 3b). On T2-weighted images, a high-intensity area with an irregular margin was observed (Fig. 3c).

FDG-PET, which is associated with anaerobic glycolytic metabolism, showed an obvious accumulation in the right knee, corresponding to the cystic lesion of the patella (Fig. 4a). The standardized uptake value (SUV), which indicates the accumulation semiquantitatively,[9,10] was 1.4, suggesting a benign lesion, but not a benign bone tumor, such as giant cell tumor (GCT), chondroblastoma, or sarcoidosis.[10] In contrast, FMT-PET analysis revealed an obscure accumulation of the amino-acid

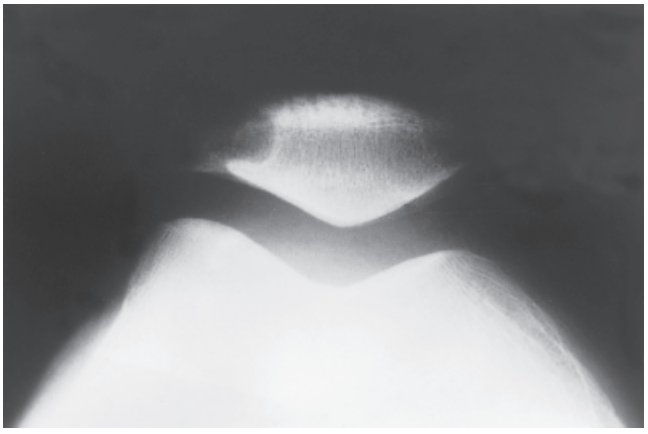


Fig. 1. Plain radiograph. Skyline view clearly shows destruction of the patella partita

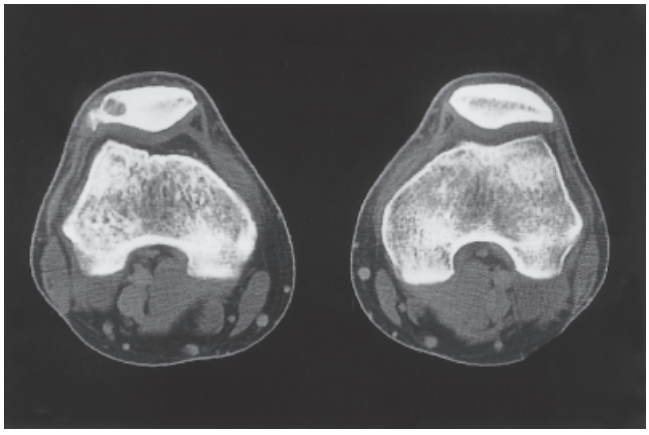
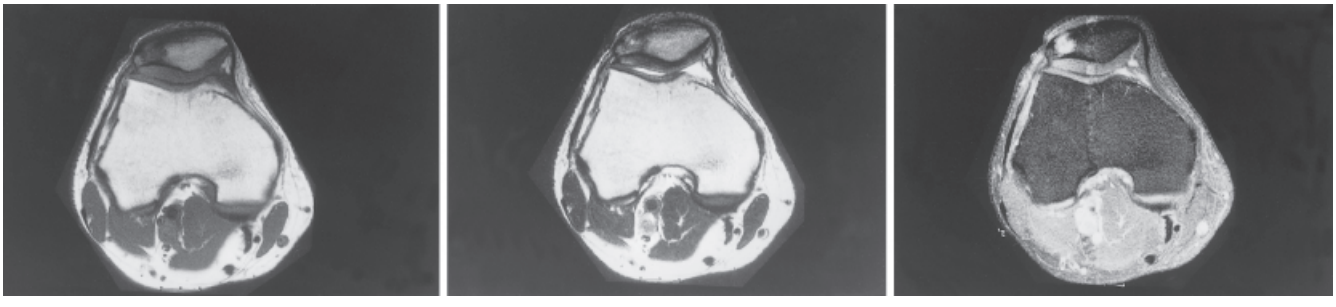


Fig. 2. Computed tomography (CT) revealed a cystic lesion in the right patella, with a sclerotic rim, and irregular high-density spotty areas in the surrounding soft tissue



a,b **c**

Fig. 3. a Magnetic resonance imaging (MRI) reveals an intraosseous lesion showing iso-intensity in relation to the synovium on T1-weighted images; **b** MRI with heterogeneous gadolinium enhancement. **c** On T2-weighted image, high-intensity areas were scattered irregularly in a low-intensity lesion

analog emitter, FMT (Fig. 4b). The FMT-SUV was 0.60, which also indicates a benign lesion.[9]

The patient had a past history of acute pain in the right knee that had occurred 8 years previously; the pain had subsided spontaneously, and we speculated that this had been a gouty episode. After examination during this admission, the patient was treated with loxoprofen sodium, a nonsteroidal anti-inflammatory drug (NSAID), and this treatment resulted in the gradual improvement of the ROM in his knee and alleviation of the pain. Benzbromarone was started after 1 week of the NSAID treatment. The patient's serum uric acid level had gradually reduced to within the normal range (7.5 mg/dl) by February 23. However, because the protrusion in the right patella and slight pain persisted, arthroscopy and resection was performed, on May 10. Arthroscopy did not show any marked changes inside the knee joint. The patella was exposed using a lateral transverse incision, and a grayish-white mud-like mass, located between a supero-lateral bone fragment and the main patella, was seen to have obliterated the superior lateral quadrant of the patella. The mass and the isolated bone fragment were excised together. The excised mass consisted of thick, chalky, white material, corresponding to the macroscopic findings of a gouty tophus.

Examination of the white material by compensated polarized light microscopy demonstrated negatively birefringent monosodium urate crystals. Microscopic examination of a specimen of the lesion revealed polynuclear giant cells around needle-like void spaces (which, we speculated, were uric acid crystals); a granular nodule formation was also observed, indicating gouty tophus.

One and half years after the operation, there has been no recurrence of a gouty episode, and the patient's serum uric acid level has been maintained within the normal range. The atrophy of the quadriceps muscle has become markedly reduced.

Discussion

Gouty tophi are commonly found in articular and other cartilages; in synovium, tendon sheaths, and other peri-

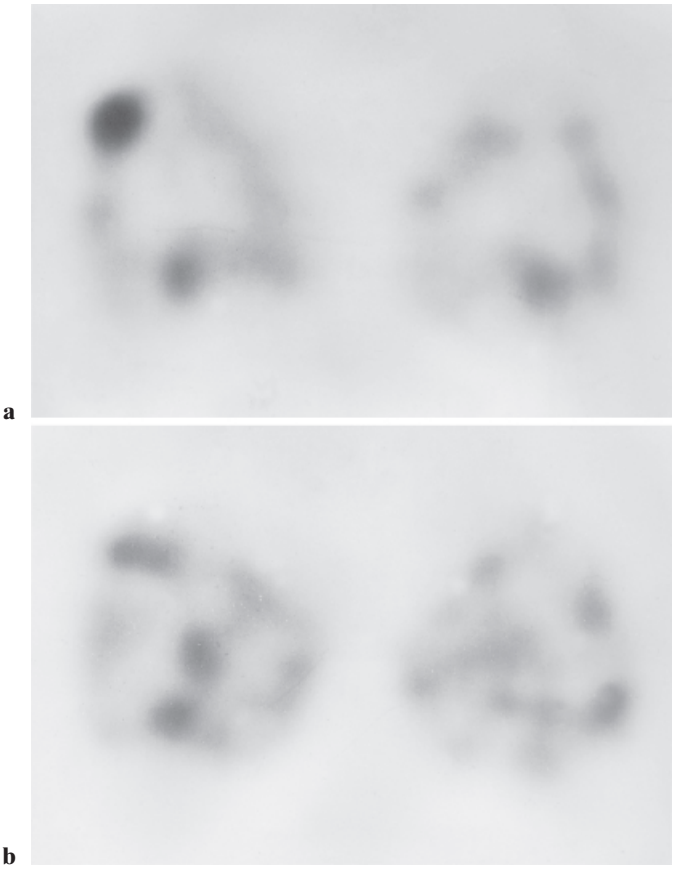


Fig. 4. a ^{18}F-fluoro-2-deoxy-D-glucose (FDG)-positron emission tomography (PET) shows an obvious accumulation in the right knee, corresponding to the cystic lesion of the patella, with a standardized uptake value (SUV) of 1.4. **b** In contrast, L-[3-^{18}F]-alpha-methyl tyrosine (FMT)-PET analysis showed obscure accumulation of FMT. (SUV, 0.60)

articular structures; in epiphyses, and in subcutaneous layers of the skin in the extremities. Intraosseous gout of the patella is rare, and was reported for the first time in 1955.[7] Several reports have described gouty tophus occurring in the bipartite patella,[2] since the first description by Reber et al.[8] In the present patient, no abnormal alteration was observed inside the knee joint on arthroscopic examination, indicating that the primary lesion where crystal deposition occurred may not have been the joint structure (including synovium, articular cartilage, and intraarticular ligamentous tissues). Plain radiograph showed a separated fragment, which suggests a bipartite origin. These findings suggest that uric acid crystals may have been formed primarily in the granulomatous tissue between the bony fragments of a bipartite patella.

A definite pathogenetic diagnosis could not be established by the usual radiological modalities, because of the unusual site of the gouty tophus. Radiographic differential diagnosis of the lesion includes benign lesions such as infection,[5] rheumatoid arthritis, and benign bone tumors,[3,4] as well as malignant neoplasms, including metastatic carcinomas.[1,6] In recent years, PET imaging, utilizing a variety of positron emitters, including FDG and FMT, has been used in the evaluation of bone and soft-tissue tumors, because these metabolite analogs accumulate well in musculoskeletal mass lesions.[9] The FMT-SUV, a semiquantitative analysis of PET imaging, clearly differentiates malignant tumors from benign lesions, with a cutoff value of 1.2;[9] the FMT-SUV in the present patient was 0.60, indicating a benign lesion. Thus, FMT-PET may be useful for the differentiation of gouty tophus from malignant bone tumors.

A high percentage of malignant tumors show a high accumulation of FDG, which suggests that FDG has high sensitivity for the diagnosis of malignancy.[10] However, high accumulation of FDG has also been observed in several kinds of benign lesions.[9,10] Benign lesions with a high SUV, of more than 1.9, included osteomyelitis, rheumatoid arthritis, and benign bone tumors, such as GCT of bone, fibrous dysplasia, eosinophilic granuloma, chondroblastoma, xanthofibroma, and sarcoidosis in bone.[9,10] Most of these benign lesions should be considered in the differential diagnosis of gouty tophus in the patella.[3–5,8] In our patient, however, the FDG-SUV was 1.4, indicating mild accumulation of FDG, which implies a benign lesion. FDG-PET may thus be useful for the differentiation of gouty tophus from most benign bone lesions, simulating the radiolgraphic findings. On the other hand, a mild accumulation of FDG may also play a role in the differentiation of gouty tophus from bone-resorbing conditions such as bone cyst, intraosseous ganglion, and lipoma, as little accumulation of FDG has been reported in these conditions; rather, the presence of these conditions was sometimes depicted as a void area.[9,10] Therefore, PET studies may be useful in the pathogenetic diagnosis of gouty tophus in the patella, although the mechanisms by which the PET tracers used here accumulate in areas of gouty inflammation are still uncertain at present.

In conclusion, gouty tophus of the patella, a rare lesion, was evaluated using PET images. The two positron emitters used here accumulated in the gouty tophus, suggesting the usefulness of PET for the detection of these lesions. Furthermore, this modality, using a combination of FMT, which neglects malignancies, and FDG, which neglects benign lesions, simulating the radiographic findings, may be useful for the diagnosis of gouty tophus occurring in patella partita.

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