

Magnetic resonance imaging of a pediatric case of arthritis associated with acute lymphoblastic leukemia: A case report

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Abstract. In the present case report, a 3-year-old girl presented with a 1-week history of spontaneously resolving right knee pain. After 1 month, the patient had trouble ambulating due to painful swelling of their ankle. Rheumatic disease, specifically juvenile idiopathic arthritis, was considered. Blood examination could not be conducted because their blood sample was coagulated. T₁-weighted magnetic resonance imaging (MRI) revealed abnormally low signals in the femur, tibia, fibula and foot bone marrow. Contrast-enhanced T₁-weighted MRI revealed synovial contrast enhancement and synovial fluid retention in the right ankle joint. Blood analysis revealed a white blood cell count of 40,000/ μ l (blasts, 66%). In addition, a monoclonal increase in the number of lymphoblasts was observed. The patient was subsequently diagnosed with B-cell precursor acute lymphoblastic leukemia. Reports on leukemic arthritis resembling synovitis on MRI remain limited. The findings of this report indicated that pediatricians should consider leukemia in children presenting with joint symptoms.

Introduction

Joint symptoms in children are caused by various etiologies, such as trauma, bacterial infection, rheumatic diseases, and malignancy. Joint symptoms of malignant diseases include those caused by bone metastasis from solid tumors, such as neuroblastoma, and those caused by hematological malignancies, such as leukemia. Leukemia, which is a hematopoietic malignancy, is the most common malignant disease in children. Patients with acute lymphoblastic leukemia (ALL), presenting with joint symptoms, are at risk of being

misdiagnosed with a rheumatic disease, such as juvenile idiopathic arthritis (JIA) (1), especially when the symptoms present asymmetrically in the lower limbs and leukemic cells are not found in the blood. This study presents a pediatric case of ALL with arthritis that was initially suspected to be JIA. The magnetic resonance imaging (MRI) findings of the bone marrow in children with leukemia have been extensively characterized. However, the MRI findings of arthritis, associated with leukemia in children, remain limited. We describe the MRI findings of a pediatric patient with ALL, presenting with joint symptoms.

Case report

A three-year-old girl presented with a one-week history of spontaneously resolving right knee pain. One month later, she had difficulty ambulating due to the painful swelling of her ankle. No fever was noted. Her past medical and family histories were unremarkable. Physical examination revealed a swollen right knee, and no lymphadenopathy was noted. Rheumatic disease, specifically JIA, was considered a differential diagnosis. Blood counts could not be obtained because her blood sample was coagulated. Blood biochemistry yielded the following results: aspartate aminotransferase, 26 IU/l; alanine aminotransferase, 8 IU/l; lactate dehydrogenase, 478 IU/l; and C-reactive protein, 1.27 mg/dl.

The following day, imaging revealed abnormal low-intensity signals in the bone marrow of the femur, tibia, fibula, and right foot (coronal T₁-weighted MRI, Fig. 1A). On coronal contrast-enhanced, fat-saturated T₁-weighted MRI, contrast enhancement in the bone marrow was observed (Fig. 1B). On short tau inversion-recovery MRI, a high-intensity signal in the right ankle joint was noted (Fig. 1C). Lastly, synovial contrast enhancement and synovial fluid retention in the right ankle joint were observed on contrast-enhanced MRI (Fig. 1D). Since these MRI findings were suggestive of leukemia, blood analysis was performed. Blood analysis yielded the following results: white blood cell count, 40,000/ μ l (blasts, 66%); hemoglobin, 8.0 g/dl; platelet count, 52,000/ μ l; anti-nuclear antibody titer, 40; matrix-metalloproteinase-3, 14.5 ng/ml; and soluble interleukin-2 receptor, 644 U/ml. Bone marrow aspiration showed a monoclonal increase in the number of lymphoblasts. The patient was diagnosed with B-cell precursor ALL. Her

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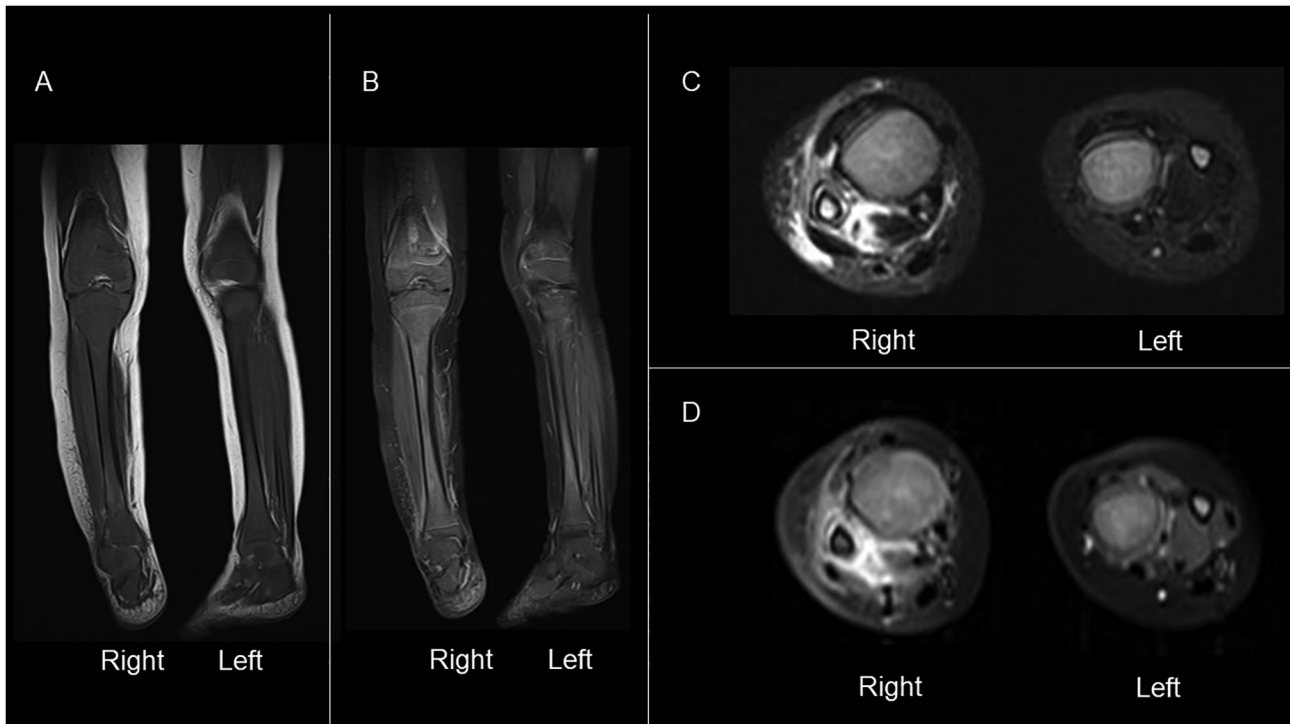


Figure 1. MRI. (A) Coronal T1-weighted MRI shows abnormally low signals in the bone marrow of the femur, tibia, fibula, and foot. (B) Coronal contrast-enhanced T₁-weighted MRI shows diffuse enhancement in the bone marrow. (C) Short tau inversion recovery MRI shows high signal intensity in the right ankle joint. (D) Contrast-enhanced T₁-weighted MRI shows a synovial contrast enhancement effect and synovial fluid retention in the right ankle joint. MRI, magnetic resonance imaging.

joint symptoms improved with chemotherapy, therefore a biopsy was not performed.

Discussion

Though well known by pediatric hematologists, general pediatricians may overlook leukemia as a cause of osteoarthritis. Osteoarthritis occurs in 8.4-35% of patients with acute leukemia (1-4). Thus, it is essential to differentiate it from JIA, which is a common childhood disease. There are reports in which cases of leukemic arthritis were misdiagnosed as JIA (1,4), especially when patients with leukemia present with asymmetrical mono- or oligoarthritis in the large joints of the lower extremities, such as the knees and ankles (3,4). The patient in this report presented with asymmetrical oligoarthritis in the right knee and ankle. Her symptoms warranted to be considered leukemia. Pediatricians should consider leukemia in children presenting with joint symptoms.

Reports in which leukemic arthritis resembles synovitis on MRI remain limited, and there is a report on adult patients but not pediatrics (5). The mechanism of leukemic arthritis is not clear. This report suggests that synovitis may be due to leukemic cell infiltration, as the flow cytometric findings of the synovial fluid were similar to those of bone marrow. However, synovial fluid has not been analyzed in our case.

Some patients in the early stages of leukemia reportedly have no leukemic cells in peripheral blood smears (1,2). Our patient had leukemic cells in her peripheral blood smear, leading to the diagnosis of acute leukemia. The absence of

leukemic cells in a blood smear may result in a misdiagnosis of JIA. Moreover, on T₁-weighted MRI, normal yellow bone marrow, which replaces the red marrow from the center of the diaphysis, has a high signal intensity. Low signal intensity at the center of the diaphysis, as seen in the present case, signifies relapsing leukemic cells (6). In a previous report, the absence of leukemic cells in the peripheral blood and the bone marrow findings on MRI led leukemia diagnosis (7). It is important to first evaluate peripheral blood to distinguish leukemia in cases presenting prolonged joint symptoms. This study highlights that evaluating the bone marrow through MRI is useful in cases where leukemic cells are absent from the peripheral blood smear. The limitation of this study is that there is only one case. It is not clear whether the same can be said for other cases, and further studies are needed in the future.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

YF collected and analyzed the data, and drafted and revised the initial manuscript. SK, TK, MS, MI, YS and SY interpreted all the data and critically revised the manuscript for important intellectual content. YF, SK, YS and SY confirm the authenticity of all the raw data. All the authors read and approved the final manuscript, and agreed to be accountable for all aspects of the work.

Ethics approval and consent to participate

Not applicable.

Patient consent for publication

Written informed consent for publication of the data and associated images herein was obtained from the patient's guardian.

Competing interests

The authors declare that they have no competing interests.

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