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CASE REPORT

Diagnosis and triage of a patient with an extra-osseous fat fluid level

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Abstract Extra-osseous fat fluid level is rarely seen in osteomyelitis, with only three magnetic resonance imaging (MRI) cases previously reported in the literature. The rarity of this finding is probably secondary to the extensive necrosis of bone marrow that needs to occur at a rapid phase for the fat to accumulate. However, an extra-osseous fat fluid level is a specific diagnostic sign of osteomyelitis in cases with otherwise equivocal imaging findings and should be reported as such, especially when associated with medullary bone destruction and in the absence of trauma.

Keywords Extra-osseous fat fluid level · Osteomyelitis

Introduction

Osteomyelitis has ominous implications in children, necessitating extendedintravenous antibiotic regimens, catheter associated complications, impaired bone growth, pathologic fracture, and bacteremia. Cross-section imaging has become the cornerstone of an accurate and timely diagnosis to triage patients and guide clinical management. The following case exemplifies how the observation of an extramedullary fat fluid level expedited the patient's treatment, which required immediate surgical intervention. A literature review revealed only three prior magnetic resonance imaging (MRI) cases of osteomyelitis presenting with an extra-osseous fat fluid level [1–3]. Our case also provides a detailed description of the surgical intervention, which historically has been the primarily treatment for chronic osteomyelitis.

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Case report

A 5-year-old girl presented to the emergency room with complaints of fever and leg pain. The child's mother reported a crush injury sustained while playing on a large piece of furniture 2 days prior. Immediately after the injury, the child was able to bear weight.

At presentation to the emergency room, the patient had decreased active and passive range of motion along with pain and swelling in the left knee and quadriceps regions. She was febrile to104°F. Laboratory findings included: white blood cell count of 6.5 (5–15) K/mm, erythrocyte sedimentation rate (ESR) of 86 (0–20) mm/h, D-dimer of 2.85 (<0.50 μg/ml), and C-reactive protein (CRP) of 17.374 (0.20–0.85 m). The laboratory workup for sickle cell anemia was negative.

The radiographs of the left femur were normal. A computed tomography (CT) examination of the left thigh was obtained. It revealed a fat fluid level with intact femoral cortex (Fig. 1).

Subsequently, MRI of the left femur demonstrated heterogeneous STIR and serpiginous low to intermediate T1-weighted signal in the medullary cavity of the distal femur (Figs. 2 and 3).

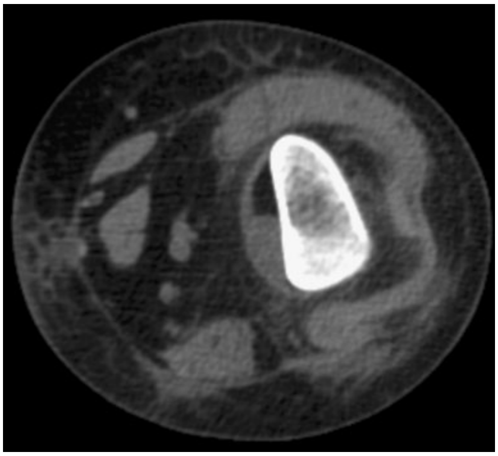

Fig. 1 Axial CT image of distal femur shows extramedullary fat-fluid level with intact cortex

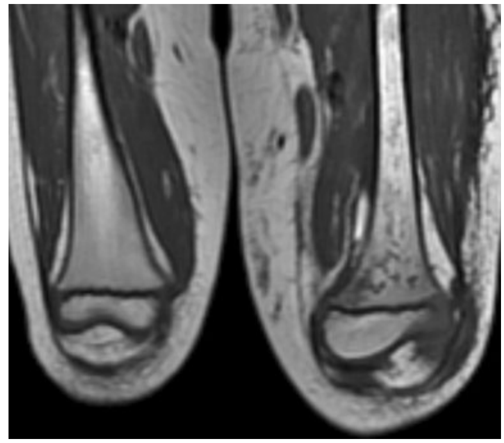

Fig. 3 Coronal T1-weighted sequence demonstrating serpiginous low to intermediate intramedullary signal

Again, a fat-fluid level posterior to the distal femur was noted. Post-contrast images demonstrated a subperiosteal abscess involving the distal femur, primarily (Fig. 4).

The abscess extended along the posteromedial aspect of the femoral shaft to near the subtrochanteric region of the femur. A minimal knee joint effusion was seen. The epiphyses were intact.

At surgery, upon elevation of the vastus lateralis, there was purulent material, which was felt to originate from an abscess extending into the suprapatellar bursa, proximally and medially. Approximately 100 ml of purulent material was extracted during surgery. The muscles themselves exhibited a normal appearance and had a normal twitch response. The fascia also appeared normal. A drill hole was made in the distal lateral cortex of the femur and curette with suction of the medullary cavity was performed. Once the purulent material was removed, necrotic tissue was then excised from the bursa. The wound was irrigated thoroughly and surgical drains were placed, followed by closure. The purulent material grew methicillin-resistant *Staphylococcus aureus*. The patient was placed on the appropriate antibiotic and subsequently discharged from the hospital after a few days following placement of a PICC line to be followed in orthopedic clinic.

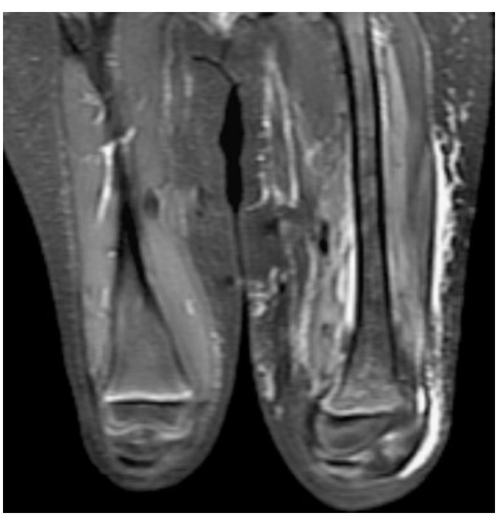

Fig. 2 Coronal STIR sequence exhibiting heterogeneous bone marrow signal

Discussion

Primary or hematogenous osteomyelitis is not uncommon in children, and there is predilection for the metaphyses of the tubular bones. Eighty to ninety percent of these cases are caused by *S. aureus* infection [5].

Radiographs are usually the initial study acquired but less than one third of patients with osteomyelitis demonstrate radiographic evidence of bone involvement in the first 7–10 days [4]. The earliest radiographic sign of osteomyelitis is deep soft-tissue swelling, while periosteal reaction is the earliest osseous finding, which is seen more often in children than adults. Radiolabeled bone scanning (i.e., technetium-99) is more sensitive for osteomyelitis than radiography but is less accessible in an emergent setting.

CT is often the study of choice and may demonstrate altered bone marrow attenuation in case of osteomyelitis. Rafii et al. [6] was the first author to report the association of intra-osseous and extramedullary fat-fluid level and osteomyelitis utilizing CT. CT can also exhibit soft tissue edema, abscesses, periosteal reaction, involucrum and cloaca formation, and exhibit bone sequestra in cases of chronic osteomyelitis.

MRI is the most sensitive modality in the detection of acute osteomyelitis. The normal bone marrow signal is replaced by low/intermediate T1-weighted and high STIR/T2-weighted signal. In addition, MR readily demonstrates

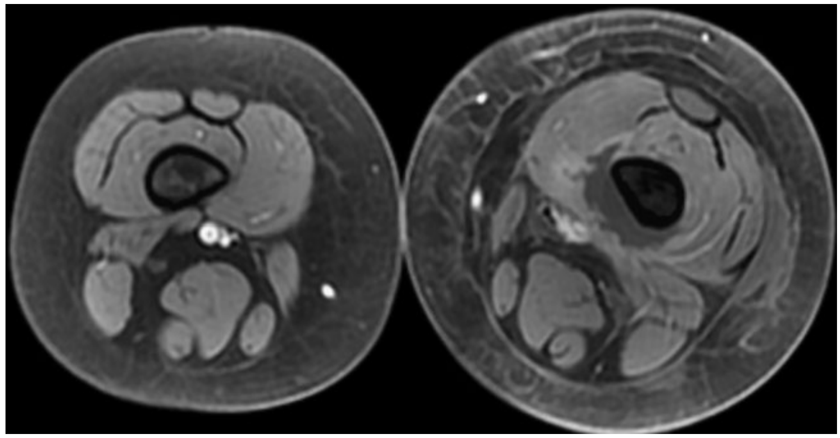

Fig. 4 Axial Spoiled Gradient Recalled Acquisition in Steady State (SPGR) imaging with Contrast demonstrating a subperiosteal abscess

an extramedullary fat-fluid level. However, one must consider the differential of a soft tissue mass with a fat-fluid level, which includes lymphangioma, dermoid cyst, and liposarcoma. Lymphangiomas are congenital lesions that arise from sequestered lymphatic sac and most commonly present as cervical masses [7]. Liposarcoma is a rare tumor but the most common subtype of soft tissue sarcomas [8, 9]. Liposarcoma occurs in five categories: well-differentiated, myxoid, round cell, dedifferentiated, and pleomorphic liposarcomas. The anatomic location of liposarcoma tends to be related to the histologic type. Well-differentiated liposarcoma occur in deep soft tissues of both the limbs and the retroperitoneum. Myxoid, round-cell, and pleomorphic liposarcomas have a predilection for the limbs, and dedifferentiated liposarcoma occurs predominantly in the retroperitoneum. Dermoid cysts can present in childhood but are usually located in the head and neck region. However, an extremely rare case has been reported in the lower extremity [10].

Our case shows the typical findings of osteomyelitis along with the rarely reported finding of an extramedullary fat fluid level in the posterior compartment of the thigh on both CT and MRI. Fat fluid levels in the setting of trauma have been well established to correlate with intra-articular fracture. In these cases, shear injury and resultant cortical disruption lead to seepage of fat globules from the medullary cavity, which layer and result in the formation of lipohemarthrosis [1–3]. The mechanism of fat fluid level may be related to rapid septic necrosis of adipose cells in the bone marrow, which releases free fatty globules, rather than shear injury. The layering of lipid and purulent material results in the formation of the fat fluid level.

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