Transient osteoporosis of the foot

Bone marrow edema in 4 cases studied with MRI

Emilio Calvo, Luis Alvarez, Dario Fernandez-Yruegas and Carlos Vallejo

Department of Orthopaedic Surgery, Fundación Jiménez Díaz, Autonomous University of Madrid, Av. Reyes Católicos, 2, Es-28040 Madrid, Spain. Tel +34 1 549-4152. Fax -4764
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We report 4 patients with transient bone marrow edema of the foot.

Case 1

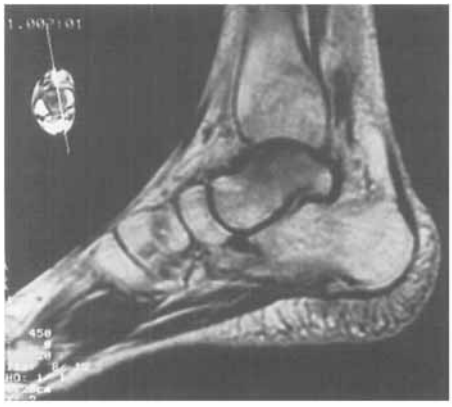
A 55-year-old woman who previously had been treated for bilateral avascular necrosis of the femoral head, presented with pain on weight bearing in the right ankle and foot for 3 months. She denied trauma or previous episodes of fever. Calcitonin had been given without benefit. Motion of the ankle was slightly restricted. Laboratory tests were normal. Radiographs revealed osteopenia of the right foot and a ^{99m}Tc bone scan showed increased uptake of isotope in the foot and ankle. MRI showed decreased and increased signal intensity for T1- and T2-weighted images, respectively, predominantly localized in the body of the talus, but extending to the neck and head.

The patient was symptomatically treated with anti-inflammatory medication and protected weight bearing. The symptoms resolved during the following 6 months. At this time, radiographs and MRI of the foot were normal.

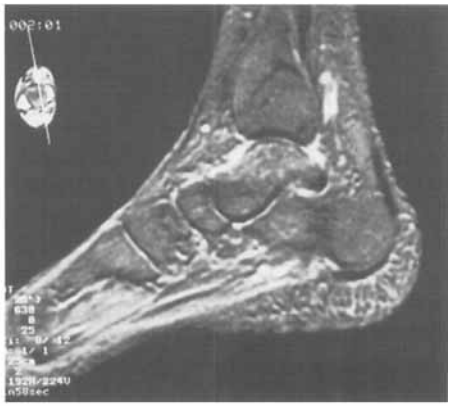
Case 2

A 59-year-old man presented with a painful right foot for 5 months. His past medical history was unremarkable. On physical examination, there was slight swelling and tenderness along the dorsal midtarsal area. Laboratory tests were normal. Radiographs revealed diffuse osteopenia of the foot. A ^{99m}Tc bone scan showed a markedly increased, homogeneous uptake in the midtarsal foot and ankle.

Case 1. A. Osteopenia and cortical thinning.



B. T1 image shows a low signal intensity in the talus.



C. T2-weighted images reveal an increase of the signal intensity in the same area. There are no alterations in bone marrow intensity of the tibia.

Case 2. A. Decreased signal intensity on a T1-weighted image from talus head into the neck and body region.

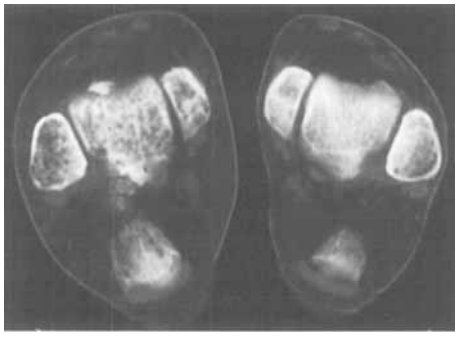
B. Hyperintense to isointense signal on a T2-weighted image. Note peritalar soft tissue swelling.

On T1-weighted MR spin-echo images, the normally high intensity of the bone marrow in the talus head and neck was replaced by a relatively low signal intensity. The abnormal signal extended into the body of the talus. On gradient-echo T2-weighted images, the abnormal area displayed relatively high signal intensity. A small area of soft tissue edema was also present.

The patient was treated symptomatically and the pain gradually subsided in 3 months. MRI was normal after 4 months.

Case 3

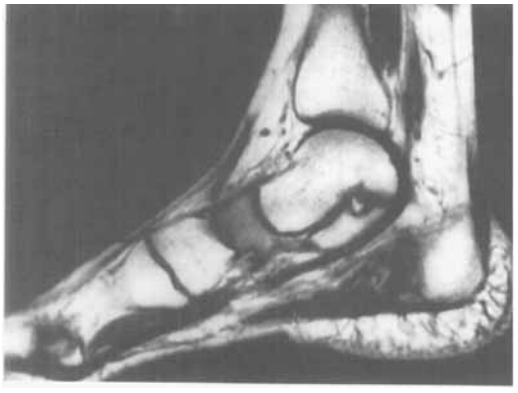
A 48-year-old golf instructor with right foot pain for 3 months had no history of trauma. He had been treated in our department 1 year before for osteonecrosis of the femoral condyle. On physical examination, there was tenderness over the dorsum of the foot. Routine laboratory tests were normal. Radiographs of the foot were normal, but a bone scan revealed increased uptake of isotope in the midtarsal area. CT revealed osteopenia of the ankle and mild soft tissue swelling. MRI showed a decreased signal intensity in the head of the talus on the T1-weighted images. The T2-weighted images revealed an increased signal intensity in the same area and in soft tissues around the affected bone.



Case 3. A.CT shows osteopenia around the ankle joint.

B. A T1-weighted MRI reveals heterogeneously decreased marrow signal involving the talar head.

C. T2-weighted MRI demonstrates high signal intensity in the abnormal area and soft tissue edema.



Case 4. A. A T1-weighted scan shows homogeneously decreased signal intensity in the navicular.

B. 3 months after decompression a T1-weighted MRI demonstrates normal bone marrow intensity of the navicular in comparison with adjacent bones. The decompression tracks are still visible.

The clinical course was the same as in the previous cases and MRI was normal after 6 months.

Case 4

A 45-year-old previously healthy woman developed pain in her right foot on weight bearing. She had no history of injury. The pain had persisted for 4 months when the patient was first seen by us, and only pain on midfoot palpation was detected by physical examination. Routine laboratory tests were normal, and plain anteroposterior and lateral radiographs at that time showed diffuse osteopenia. A bone scan revealed increased uptake of isotope.

Decreased signal intensity was observed in the bone marrow of the tarsal navicular on T1-weighted MR images. T2-weighted images showed that the corresponding region had hyperintense signal intensity relative to that of normal marrow.

A core decompression of the navicular through several punctures, using a 3-mm trephine, was performed and on histologic examination, fat necrosis, edema and reactive bone formation were noted. The bone trabeculae had normal volume density and there were no signs of osteopenia.

1 week after decompression, the patient was pain-free and MRI scan 3 months after surgery revealed only changes secondary to the decompression, with complete resolution of the abnormal signal intensity.

Discussion

Transient osteoporosis has been defined as spontaneously occurring pain and osteopenia of the involved bone. The pain increases rapidly and is often accompanied by swelling. It may last up to 2 years, and then disappear. The proximal femur is by far the commonest bone involved (Lakhanpal et al. 1987). Other bones can be affected, but only a few cases involving the foot have been reported (Duncan et al. 1967, O'Mara and Pinals 1970, Lakhanpal et al. 1987, Gallant et al. 1994). Routine laboratory investigations of blood are usually normal, but a slight increase in erythrocyte sedimentation rate has been reported (Hunder and Kelly 1968, Tannenbaum et al. 1980, Lakhanpal et al. 1987). Plain radiographs show osteopenia that becomes apparent within weeks or months after the clinical onset. Radionuclide images demonstrate intense uptake, a finding that may be present before radiographic changes appear (O'Mara and Pinals 1970). CT scanning shows loss and thinning of trabeculae.

Before MRI became available, disorders of bone marrow had to be visualized with plain radiography, CT or radionuclide bone scanning. These methods, however, provide limited information. A large amount of trabecular bone loss must occur before it can be seen on radiographs. The same difficulty accounts for the negative findings on CT scanning. Bone scans are more sensitive, but their specificity is low. Because of the nonspecific nature of the clinical symptoms and the radiographic and radionuclide findings, the early diagnosis of this syndrome is difficult, and it must be distinguished from other lesions like neoplasm, infection, avascular necrosis, stress fracture, and reflex sympathetic dystrophy. Our cases, with a delay in diagnosis of several months, illustrate these difficulties.

MRI findings in transient osteoporosis affecting the foot include a decreased marrow signal on T1-weighted images. Progressive T2-weighting yields a progressive marrow signal; the affected areas were isointense to normal marrow on intermediate-weighted images, and hyperintense on T2 -weighted images, suggesting presence of bone marrow edema. A wide

area of the bone is affected in a diffuse manner, without a localized abnormality. Marrow edema, hyperemia and fat necrosis in the involved bone contribute to these MR findings. This suggests that transient osteoporosis is a primary disease of the bone, with secondary involvement of the surrounding soft tissues. Tarsal bones seem to be more commonly affected in the foot, and no cases have been reported involving the forefoot. Traditionally, the ankle and foot have thought to be often simultaneously affected in transient regional migratory osteoporosis (Lakhanpal et al. 1987, Gallant et al. 1994). This opinion is supported by the radiographic and radionuclide findings in cases previously reported (O'Mara and Pinals 1970, Tannenbaum et al. 1980, Lakhanpal et al. 1987).

The more or less evident focal loss of radiodensity in the affected femur and its subsequent spontaneous recovery prompted Hunder and Kelly (1968) to use the term "transient osteoporosis," and since it may follow a migratory or recurrent course, the term "transient migratory osteoporosis" was used to describe this syndrome (Tannenbaum et al. 1980). Since MR has been ingreasingly used to detect obscure skeletal disorders, a distinct type of marrow edema has been found in patients suffering from this syndrome (Bloem 1988). The combination of a regional subtly decreased bone marrow signal intensity on T1-weighted images with an increased signal intensity on T2-weighted images, without evidence of a mass suggests an increase in the water content of the bone marrow. In addition, osteoporosis is a rare finding when bone biopsies have been performed in these patients (Wilson et al. 1988, Hofmann et al. 1993). For this reason, Wilson et al. (1988) have suggested that the term "transient osteoporosis" should be replaced by that of "transient bone marrow edema syndrome."

Several studies have noted a relation between transient bone marrow edema and avascular necrosis (Hauzeur et al. 1989, Robinson et al. 1989, Seiler et al. 1989, Turner et al. 1989, Hofmann et al. 1993). Although no conclusions can be drawn, the fact that 2 of our cases had been treated for osteonecrosis in other bones is noteworthy. Based on the theory that transient osteoporosis of the hip might be an early stage of avascular necrosis (Turner et al. 1989) and that pain is caused by increased intramedullary pressure, core decompression has been recommended to reduce the duration of symptoms (Hofmann et al. 1993). There is no report about decompression in transient osteoporosis of the foot, but our fourth patient became pain-free immediately after decompression.

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