Quarterly radiology case

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A 16-year-old female complained of progressively severe aching pain in the left ankle for 1 month. There was no history of trauma. Two years previously, an operative procedure had been performed on the left knee. Physical examination revealed slight soft-tissue swelling over the anterolateral aspect of the distal left tibia. Radiographic and scintigraphic studies are shown below (Figures 1-4). A surgical procedure subsequently was performed.

DIAGNOSIS: Brodie's abscess of the tibia.

DISCUSSION

A bone abscess (Brodie's abscess) is a well-delineated focus of active infection that can vary in size and can occur at single or multiple locations. The abscess is lined by granulation tissue and frequently is surrounded by eburnated bone.

The term osteomyelitis, introduced by Nelaton in 1844, implies infection of bone and marrow. Osteomyelitis usually is secondary to bacterial infection, although fungi, parasites, and viruses also can infect bone and marrow.

Infective (suppurative) osteitis usually indicates inflammation of only the bone cortex. Noninfectious osteitis may be caused by numerous conditions, such as ankylosing spondylitis, psoriasis, and Reiter's syndrome.

Infective (suppurative) periostitis implies infection of the periosteum surrounding the bone. Bone necrosis may develop as a result of interruption of the periosteal blood supply to the cortex, or the periostium may become disrupted with the accumulation of pus in the soft tissues.

Radiography usually is unable to delineate the precise extent of the infection (suppurative periostitis, osteitis, or osteomyelitis). Furthermore, periostitis may be present in the absence of infection and can occur in neoplastic, metabolic, inflammatory, and traumatic disorders. Soft-tissue infection can produce inflammation of adjacent periosteal tissue (periostitis) without the presence of infection in the periosteum.

Several descriptive terms have been applied to certain radiographic and pathologic phenomena that are encountered during the natural history of osteomyelitis. A sequestrum is a piece of necrotic bone that is separated from living bone by granulation tissue. Sequestra may remain in the marrow for protracted periods of time, providing
an environment for living organisms that have the potential to evoke an acute exacerbation of the infection. An **involutr**um indicates a layer of living bone that has developed around dead bone. This can surround and eventually merge with the parent bone or can become perforated by tracts that permit pus to escape. An opening in the involucrum, which can discharge granulation tissue and sequestra, is referred to as a **cloaca**. Tracts leading from the bone to the skin surface are termed **sinuses** or **fistulae**. The latter term, however, usually describes an abnormal communication that exists between 2 internal organs or that extends from 1 internal organ to the surface of the body. A sclerotic, nonpurulent form of osteomyelitis, **Garr?’s sclerosing osteomyelitis**, is a rare type of osteomyelitis that most commonly occurs in the mandible and typically is secondary to **Staphylococcus aureus** infection.

The 4 principal routes by which osseous structures can be contaminated are hematogenous spread of infection, spread from a contiguous source of infection, direct implantation, and postoperative infection.

In hematogenous spread of infection, bacteria usually enter the blood vessels by direct extension from extravascular sites of infection in the genitourinary, gastrointestinal, biliary, or respiratory systems or from infection in the skin or other soft tissues. Surgical manipulation or instrumentation, especially in sites of large, indigenous bacterial flora such as the colon and teeth, and the use of various intravascular devices also can be sources of bacteria.

Although neonatal osteomyelitis is well known, hematogenous osteomyelitis traditionally has been regarded as a disease of childhood (3 to 15 years of age). There has been, however, an increase in the incidence of hematogenous osteomyelitis in older patients. There are major clinical and radiologic differences in the presentation and course of hematogenous osteomyelitis in infants, children, and adults. In infants, infected indwelling umbilical venous and arterial catheters can be the source of septicemia that results in osteomyelitis at multiple sites. In this age group, pain, swelling, and an unwillingness to move the affected bones frequently are associated with the condition. Childhood osteomyelitis can be associated with the sudden onset of high fever, a toxic state, and local signs of inflammation, although these symptoms and signs are not always observed. The adult form of the disease may have a more insidious onset, with a relatively longer period between the onset of symptoms and the correct diagnosis. In all age groups, prior administration of antibiotics can attenuate or alter both the clinical and the radiologic manifestations of the disease.

As infants, males and females are affected by osteomyelitis with equal frequency. Most studies indicate that in children, however, boys are affected more frequently than girls, with a similar male dominance occurring in adults.

Hematogenous osteomyelitis can involve single or multiple bones. Involvement of multiple bones is common in infants. In children, the long tubular bones of the extremities (such as the femur, humerus, and tibia) frequently are involved. In the adult, osteomyelitis frequently is present in the spine.
Although many organisms can cause hematogenous osteomyelitis, *Staphylococcus aureus* is responsible for the majority of cases. Gram-negative, mycobacterial, and fungal organisms, and, less commonly, *Haemophilus influenzae* and *Streptococcus pneumoniae* also may be the causative agents. In infants, group B streptococcus has reemerged as a causative agent of osteomyelitis. This organism typically involves a single bone, frequently the humerus.

A recent surgical procedure (as in this case) or the presence of concurrent soft-tissue infection frequently is associated with staphylococcal septicemia and osteomyelitis. Gram-negative septicemia and osteomyelitis may be initiated by disorders of the gastrointestinal or genitourinary tracts. An acute or chronic respiratory infection usually is the source of infection in tuberculous, fungal, and pneumococcal osteomyelitis.

Radiographic evidence of significant osseous destruction usually is not present in hematogenous osteomyelitis for a period of days to weeks. Because radiographs are insensitive early in the disease process, scintigraphy or magnetic resonance imaging is sometimes used to establish the diagnosis. Computed tomography is used primarily for the identification of sequestra.

**Reference**

Figures 1-4