Hematogenous Osteomyelitis in Juveniles: An Examination of Pathophysiology and Variation in Occurrence in the Archaeological Record and Contemporarily

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Osteomyelitis is a general term for a group of diseases that cause inflammation of the bone. In most cases, the cause is infectious agents entering the bloodstream from other infected areas, especially traumatic or surgical wounds. Hematogenous osteomyelitis. The main causative agents are Staphylococcus aureus (staph) and Streptococcus (strept). Other causes of osteomyelitis include indirect infection from soft tissue infections or sepsis (Ortner 2003, 181). Although osteomyelitis can occur at any age, acute hematogenous osteomyelitis (AHO) is particularly prevalent among juveniles. Osteomyelitis is usually located in the metaphysis of long bones, specifically the femur, tibia, or in the humerus, about 75% of cases, (Figure 1). After gaining entry into the bone, resulting increased pressure leads to ischemia, vascular compromise that causes the bone to die, and forms involucrum. Eventually involucrum will also form, which is a layer of new bone growth outside of existing bone (Figure 2).

Paleopathological recognition and analysis of skeletal remains is typically incomplete even though osteomyelitis is considered to be frequent in prehistoric times. In skeletal remains, the criteria for diagnosis of osteomyelitis include the presence of cloaca (opening in bone that allows for drainage), sequestrum, and involucrum (Flensborg et al. 2013, 128-129) (Figure 3).

Osteomyelitis in Past Populations

The first case of osteomyelitis seems to have occurred in the posterior dorsal spine of a Permian reptile, which was in existence over 250 million years ago, indicating the disease has been encountered at an early point and has had a long history. Associated with open wounds and not really able to be treated until the advent of antibiotics, osteomyelitis should have frequently infected early man, but the literature does not provide much proof of its existence prehistorically. Even later in cases of ancient Egyptian mummies that frequently had open fractures, evidence of bone infection was extremely rare. However, it is not clear whether bone in early man and even in Egyptian mummies is just not well preserved enough to provide evidence on osteomyelitis or if those who had osteomyelitis (or other factors like open fractures) lived long enough for the disease to show up pathologically on the bones (Eid 2003, 95).

Osteomyelitis Contemporarily

Advances in diagnostics have highlighted a need to review the current treatment practices. Early treatment is especially important in children, as a delay in diagnosis may cause growth disturbance, bone deformities, or even death. Osteomyelitis occurs between 1 and 13 per 100,000 and accounts for around 1% of all hospital admissions in children. Notably, boys are nearly twice as commonly affected as girls (Jaramillo et al. 2017, 630). Most children and adolescents initially present with a history of bone pain over several days. Other signs of AHO include more localized bone pain (usually found in older children who can express pain location better), and fever.

Diagnosis of osteomyelitis includes a variety of methods including laboratory tests and physical examination which are very suggestive. More definite methods usually rely on imaging techniques such as the commonly known CT and MRI and the newer skeletal scintigraphy which allows for a whole-body survey. Even with all of these methods, isolation of the causative agent remains the only way to establish a definitive diagnosis of the disease. After definitive diagnosis occurs, specific antimicrobial treatment can then be created for the individual (Harik and Smeltzer 2010, 177-178). In recent years, the current understanding of the etiology of osteomyelitis has changed, as Kingella kingae becomes an increasing causative agent in new infections, and there also has been an increase in Methicillin-resistant Staphylococcus aureus (MRSA) infections (Jaramillo et al. 2017, 630). It is important to understand the etiology of the disease as it determines the causative agent, which not only allows for the most definitive diagnosis, but also determines specific treatment that can be created.

References


Figure 1. Skeletal distribution of osteomyelitis in children (Jarniloll et al. 2017, 630).

Figure 2. Osteomyelitis of the left tibia compared with the normal right tibia of a child (Ortner 2003, 201).

Figure 3. Development of osteomyelitis infection with involucrum and sequestrum (Harvey 2016).