

Osteomyelitis

(Inflammation of the Bone and Bone Marrow)

Basics

OVERVIEW

- Sudden (acute) or long-term (chronic) inflammation of bone and its associated soft-tissue elements of bone marrow, endosteum (lining of the inner surface of the bone), and periosteum (membrane covering the outer surface of the bone)
- Usually caused by bacteria and rarely by fungi and other microorganisms

GENETICS

- Breeds with inherited immunodeficiency (inability to develop a normal immune response) or blood-related diseases

SIGNALMENT/DESCRIPTION OF PET

Species

- Dogs
- Cats

Breed Predispositions

- Breeds with inherited immunodeficiency (inability to develop a normal immune response) and blood-related diseases

Mean Age and Range

- Blood-borne infections of the metaphysis (area between the end and the shaft of the bone, where bone growth occurs)—young dogs

Predominant Sex

- Male dogs—for post-traumatic infection; blastomycosis (a fungal infection)

SIGNS/OBSERVED CHANGES IN THE PET

- Sudden (acute) post-operative wound infections after orthopedic surgery may mimic signs of sudden (acute) osteomyelitis; may progress to long-term (chronic) disease
- Most pets have long-term (chronic) disease at time of examination and diagnosis
- Lameness
- Draining tracts
- Previous trauma
- Fracture or surgery—post-traumatic disease
- Hind-limb weakness and difficulty in rising—bacterial or fungal infection of the intervertebral disks and adjacent bone of the spine (vertebral bodies; condition known as “diskospondylitis”) or inflammation of the bones of the spine (known as “vertebral osteomyelitis”)
- Travel to regions where fungal (mycotic) infections are common—fungal infection
- Sudden (acute) blood-borne disease (dogs)—sudden onset of generalized (systemic) illness; swelling over the affected area; lameness; fever (known as “pyrexia”); sluggishness (lethargy); limb pain



- Long-term (chronic) condition—chronic draining tracts, pain, loss of muscle mass (known as “muscle atrophy”), and muscle contracture
- Unhealed fractures with infection—instability, grating detected with movement (known as “crepitus”), and limb deformity
- Fungal infections—limb swelling, lameness, and intermittently draining tracts
- Bone infections of the spine—pain and nervous deficits (such as paralysis)

CAUSES

- Open fracture (that is, a fracture for which the skin is punctured, leaving an open wound to the fracture)
- Traumatic injury
- Surgical repair with metal implants of a closed fracture (that is, a fracture for which the skin was intact, prior to surgery)
- Elective orthopedic surgery
- Prosthetic or artificial joint implant
- Gunshot wound
- Penetrating foreign body
- Bite and claw wounds
- Involvement of bone from soft-tissue infection—inflammation/infection of tissues around and supporting teeth (known as “periodontitis”); inflammation/infection of the nose (known as “rhinitis”); inflammation/infection of the middle ear (known as “otitis media”); inflammation/infection of the nail bed (known as “paronychia”)
- Blood-borne infection
- Staphylococci—cause approximately 46% to 74% of bone infections, usually caused by *Staphylococcus intermedius*; often single type of bacteria (known as “monomicrobial”) infections
- More than one type of bacteria (known as “polymicrobial”) causing bone infection—common; may include aerobic gram-negative bacteria (bacteria that can live and grow in the presence of oxygen), such as *E. coli*, *Pseudomonas*, *Proteus*, and *Klebsiella*
- Anaerobic bacteria (bacteria that can live and grow in the absence of oxygen)—can be found in as high as 70% of bacteria causing osteomyelitis, include *Actinomyces*, *Clostridium*, *Peptostreptococcus*, *Bacteroides*, and *Fusobacterium*
- Fungal infection generally results from spread of the infection through the blood to the bone and/or bone marrow—*Coccidioides immitis*; *Blastomyces dermatitidis*; *Histoplasma capsulatum*; *Cryptococcus neoformans*; *Aspergillus*

RISK FACTORS

- Open fracture (fracture for which the skin is punctured, leaving an open wound to the fracture) and bone contamination
- Soft-tissue trauma
- Penetrating wounds
- Migrating foreign body
- Orthopedic surgery/implants
- Cortical bone allograft (bone graft transplanted from genetically nonidentical animals of the same species)
- Immunodeficiency (inability to develop a normal immune response)
- Nosocomial infection (infection originating in a veterinary hospital)

Treatment

HEALTH CARE

- Inpatient—surgical removal of tissue (known as “débridement”), drainage, flushing the wound (known as “irrigation”), and wound management until infection begins to resolve; infected fractures (surgical stabilization)
- Outpatient—long-term antibiotics, administered by mouth
- Depends on severity, location, and degree of associated soft-tissue injury
- Take care to prevent infections by bacterial contamination from other pets in the hospital, so-called “hospital-related” or “nosocomial” infections

- Physical therapy

ACTIVITY

- Restricted—with any danger of a fracture occurring at the site of weakened bone (known as “pathologic fracture”); with an unhealed fracture

DIET

- No restriction

SURGERY

- Long-term (chronic disease)—surgical removal of tissue (débridement); removal of pieces of dead bone or bone that has become separated from blood supply (piece of bone known as “sequestra”; procedure known as “sequestrectomy”); establishment of drainage
- Infected stable fracture—leave pre-existing metal surgical implants in place during healing
- Infected unstable fracture—remove metal surgical implants; stabilize fracture by other techniques
- Bone deficits—bone graft
- Localized long-term (chronic) infection—may resolve infection by amputation (tail, digit, limb) or by surgically removing the entire affected area (known as “en bloc resection”)—sternum, thoracic wall, lower jaw [mandible], upper jaw [maxilla]—and primary wound closure
- Remove all metal surgical implants after the fracture has healed

Medications

Medications presented in this section are intended to provide general information about possible treatment. The treatment for a particular condition may evolve as medical advances are made; therefore, the medications should not be considered as all inclusive

- Antibiotics—administer a broad-spectrum antibiotic designed to kill bacteria (known as a “bactericidal antibiotic”) into the vein (known as “intravenous” or IV administration) for 3–5 days while waiting for results of bacterial culture and sensitivity testing
- Antibiotics—depend on susceptibility of microorganisms; also consider possible toxicity, frequency and route of administration, and expense; most penetrate normal and infected bone well; must be given for 4–8 weeks, possibly longer; antibiotics should be continued for at least 2 weeks beyond resolution of the infection, as demonstrated by clinical signs and x-rays (radiographs)
- Staphylococci (dogs)—usually *Staphylococcus intermedius*, which are resistant to penicillin because of β -lactamase production; highly susceptible to cloxacillin, amoxicillin-clavulanate, cefazolin, and clindamycin
- Anaerobes (bacteria that can live and grow in the absence of oxygen)—effective antibiotics include ampicillin sodium, metronidazole, and clindamycin
- Aminoglycosides and quinolones (ciprofloxacin and enrofloxacin)—effective against gram-negative aerobic bacteria (bacteria that can live and grow in the presence of oxygen)
- Quinolones—usually used only for infections caused by gram-negative organisms or *Pseudomonas* that are resistant to other antibiotics that can be given by mouth
- Long-term (chronic) disease—continuous local delivery of drugs by antibiotic-impregnated methylmethacrylate beads or biodegradable polymers
- Long-term antifungal therapy (months) for fungal osteomyelitis—treat at least a month beyond resolution of clinical signs; example, itraconazole given continuously, may control disseminated aspergillosis for up to 2 years
- Identify other antimicrobial drugs by repeating cultures and susceptibility determination if the infection becomes unresponsive to the initial agent
- Pain relievers (known as “analgesics”) and/or nonsteroidal anti-inflammatory drugs (NSAIDs)—important to relieve pain and inflammation and to encourage weight-bearing and limb use

Follow-Up Care

PATIENT MONITORING

- X-rays (radiographs)—2–3 weeks after starting treatment and then sequentially to monitor bone healing, typically every 4–6 weeks

- Repeat bacterial culture of the bone for suspected persistent infection

POSSIBLE COMPLICATIONS

- Recurrence of osteomyelitis (inflammation/infection of the bone and bone marrow)
- Progression to long-term (chronic) disease
Cancer—rare complication of long-term (chronic) infection of fractures repaired by metal surgical implants

EXPECTED COURSE AND PROGNOSIS

- Favorable response to treatment in 90% of affected dogs; however, recurrence is possible, particularly with long-term (chronic) infections
- Sudden (acute) infection and long-term (chronic) bacterial infection of the intervertebral disks and adjacent bone of the spine (diskospondylitis)—may be cured by 4–8 weeks of antibiotics, if bone death (necrosis) is limited and no fracture is present
- Long-term (chronic) disease—resolution with antibiotics alone unlikely; provide appropriate surgical treatment
- Recurrence of long-term (chronic) infection—may occur weeks, months, or years after the last treatment; may require repeated surgical procedures
- Consider amputation in severe, long-term (chronic) infections with irreversible loss of limb function

Key Points

- Treatment is expensive and therapy is of long duration
- Favorable response to treatment in 90% of affected dogs
- Recurrence of long-term (chronic) infection is likely—may occur weeks, months, or years after the last treatment; may require repeated surgical procedures
- Long-term (chronic) disease—resolution with antibiotics alone unlikely; provide appropriate surgical treatment