Pakistan Veterinary Journal

ISSN: 0253-8318 (PRINT), 2074-7764 (ONLINE)
Accessible at: www.pvj.com.pk

CASE REPORT

Post-Traumatic Osteomyelitis and its Treatment in a Dog

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ARTICLE HISTORY

Received: March 21, 2011
Revised: March 31, 2011
Accepted: April 01, 2011

Key words:
Amputation
Dog
Post-traumatic osteomyelitis
Radiography
Remission

ABSTRACT

We aimed to present the clinical, radiographic, and microbiologic findings as well as the long-term outcome of surgical treatment in a 4-year-old Anatolian Shepherd dog with post-traumatic osteomyelitis. The dog had been treated for a fracture in the second metacarpal bone of the right extremity by osteosynthesis using an intramedullary pin 8 months ago. Radiographic evaluation demonstrated a bridging between the second metacarpal bone and the second carpal bone due to a new periosteal bone formation as well as signs of osteomyelitis in the second metacarpal bone such as deformation, irregular cortex, and sequestrum. Radiographic findings revealed that the second carpal bone, second metacarpal bone and the phalanges distal to it were amputated. Postoperatively, the animal wastreated with parenteral vancomycin and gentamicin. No dysfunction was observed during a 19-month postoperative follow-up.

To Cite This Article: Kaya M, Z Okumus, LE Yanmaz, E Dogan and E Kirecci, 2011. Post-traumatic osteomyelitis and its treatment in a dog. Pak Vet J, 31(4): 371-374.

INTRODUCTION

Osteomyelitis is described as the infection of medullary tissue, cortical bone, and periosteum. Hematogenous osteomyelitis is a rare form of bone infection in adult dogs. Iatrogenic or traumatic osteomyelitis is most commonly encountered form (Rabillard *et al*., 2011). Many of the bone infections in dogs and cats are of bacterial origin, mainly *Staphylococcus aureus, Escherichia coli* and *Proteus spp.* (Habson, 1998). Improper surgery performed under inadequate asepsis and antisepsis conditions is the foremost cause of post-traumatic osteomyelitis, whereas avascular bone, spread of adjacent soft tissue infections, and open fractures are among other causes of the disease(Braden, 1991). Moreover, it is one of the most dreaded complications of the orthopedic surgeries (Hulse and Johnson, 1997). Based on the duration of infection, it is classified in two groups: acute and chronic osteomyelitis. Treatment of chronic osteomyelitis is costly, long, and difficult. The treatment includes local and systemic use of antibiotics based on the antibiogram results, debridement surgery, management of the dead-space, and soft tissue reconstruction (Mader *et al*., 1999). In this study, short- and long-term treatment outcomes of a chronic osteomyelitis secondary to osteosynthesis applied using an intramedullary pin 8 months ago are presented.

History and clinical examination

This is case of a 4 year old male Anatolian Shepherd dog. The dog had been subjected to osteosynthesis by intramedullary pin due to a fracture in the right second metacarpal bone 8 months ago and had started to exhibit continuous limping, swelling, and fistulization in the previous postoperative period. In clinical examination, we observed moderate limping, pain on palpation, solid swelling, multiple fistulization and scar tissue formation.

Diagnosis

Radiographic examination revealed thickening in the regional soft tissue, bridging between second carpal bone and second metacarpal bone due to periosteal new bone formation, periosteal bone formation in the second metacarpal bone, irregular and deformed cortex, indistinct medullary canal due to endosteal irregular thickening, sequestrum, non-union, and intramedullary pin of the previous osteosynthesis (Fig. 1). Ultrasonography (Falco 100, PIE Medikal, US) of the metacarpal region was performed by a 5-7.5 MHz convex probe. Ultrasonographic examination revealed periosteal fluid collection, sinus tract, cortical irregularity, periosteal enlargement, and inflammatory thickening in the soft tissue (Fig. 2). Bacteriological analysis of the fistula discharge revealed *Escherichia coli, Fusobacterium nucleatum* and *Staphylococcus aureus.*

Fig. 1: Preoperative anterioposterior and mediolateral radiographs of the right distal extremity. A. Bridging with periosteal new bone formation between second carpal and second metacarpal bones; sequestrum (small figure), intramedullary pin, cortical irregularity and deformity, and nonunion of the fracture line in the second metacarpal bone. B. Thickening of the soft tissue and periosteal new bone formation.

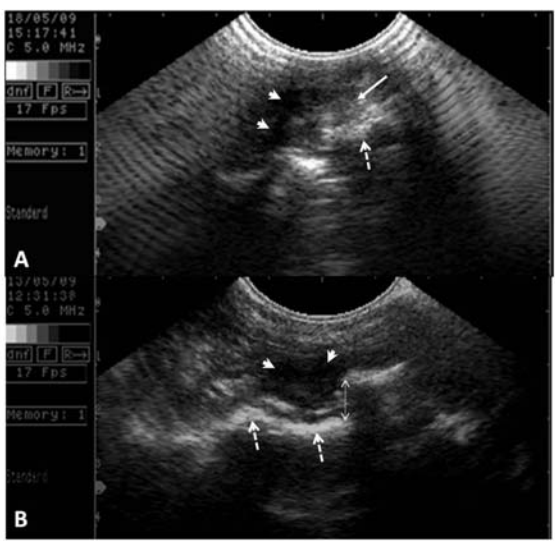

Fig. 2: Ultrasonographic view of the lesion site. A. Sinus tract (arrowheads) and periosteal reaction (white arrow). B. Nonunion of the fracture line showing lack of cortical integrity (interrupted line between the arrowheads), perosseous fluid collection (arrowheads), and cortical irregularity (interrupted white arrow).

Treatment

By surgical treatment, first metacarpal bone and the phalanges distal to it, as well as second carpal bone and metacarpal bone, and the phalanges distal to it, were removed (Fig. 3A). Fistula area was extirpated as to allow the wound edges to oppose each other gently. A systemic antibiotic (vancomycin, 10 mg/kg IV; gentamicin, 2 mg/kg SC) was applied until the third week postoperative. During early postoperative period, infection signs were alleviated, wound healing was successful without a complication, and affected extremity was participating in the gait without any pain. The dog not show any pain or limitation during the extension and flexion of the carpal joint within a 19-month follow-up. The dog was able to use his right anterior extremity without a hindrance (Fig. 4). Radiographs taken within this period displayed increased peri-articular osteophyte and minimal intra-articular osteophyte densities over the carpal joints within 19 months (Fig. 3B, C, D).

Fig. 3: Anteroposterior radiographs taken at postoperative 1 hour (A) and 19 months (B). C. Osteophytes showing intra-articular and high peri-articular density at postoperative 19 months. D. Mediolateral radiographs displaying the joint spaces during flexion of the carpal joint.

Fig. 4: Side (A) and front (B) views at postoperative 19 months.

DISCUSSION

Post-traumatic osteomyelitis can occur in cats and dogs following improper or inadequate orthopedic surgery (Braden, 1991). Indeed, metacarpal and metatarsal fractures are reported to account for 8.1-11% of all fractures in dogs, with major postoperative complications of malunion, nonunion, implant loosening and migration, osteomyelitis, degenerative joint disease, and residual lameness (Wernham and Roush, 2010). In our case, the dog was referred to our clinic due to postoperative complications of previous surgical intervention (Fig. 1). Although monomicrobial (*e.g. Staphylococcus aureus*) infection is very common in bacterial osteomyelitis cases, the prevalence of polymicrobial (*Streptococcus, Proteus, Klebsiella, Pseudomonas spp.,* and *E. coli*) infection is about 40% (Hulse and Johnson, 1997). A polymicrobial infection, with three isolated organisms, was determined in our case.

Although contamination of the surgical site during open surgery with a given microorganism is the foremost cause of osteomyelitis (Hulse and Johnson, 1997), there are other important factors involved in pathogenesis of the post-traumatic osteomyelitis. These include a, reduced or inhibited vascularization (hemorrhage, shock, avascular bone fragments, soft tissue damage, b, iatrogenic contamination (hospital-acquired or intraoperative contamination), c, biofilm formation (glycocalyx), d, hematoma formation in the dead space (due to surgery or trauma), e, destruction secondary to fixation materials (disrupted medullary blood flow during intramedullary pin insertion or excessive dissection of the soft tissue providing blood to the bone fragments), and f, suppression of the immune system by corticosteroids (exogenous or endogenous), shock, anesthesia, and surgery (Habson, 1998). Clinical symptoms of chronic osteomyelitis are continuous or intermittent limping, fistulization and fistula discharge, local pain and hypersensitivity, swelling, pyrexia, and anorexia (Habson, 1998; Hulse and Johnson, 1997). The dog was brought to our clinic because of limping, swelling over the anterior portion of the metacarpal area, fistulization and fistula discharge. These symtoms were seen after the osteosynthesis procedure. Unstable fractures and loose implants perpetuate an environment suitable to osteomyelitis (Worlock *et al*., 1994). However, inadequate fracture fixation with internal implants, resulting in unstable fractures, causes significantly higher infection rates compared with stable fractures with internal implants (Worlock *et al*., 1994). Although we did not have the chance to evaluate the radiographs concerning the previous operation, the condition of the dog was suggestive of improper or inadequate osteosynthesis (*e.g.* use of short intramedullary pin) (Fig. 1A).

Osteomyelitis cases require use of both local and systemic antibiotics. Antibiotic therapy should be applied for 6 weeks in all osteomyelitis patients. At the end of this 6-week period, a second culture is acquired from the related area through needle aspiration and if it proves to be positive, then the treatment approach should be altered and aggressive surgery should be performed. The aim of surgical exploration is to remove the focus of infection (Habson, 1998). Standard surgical procedure comprises debridement surgery for removal of sequestrum and infected tissues, drainage of the dead space occurring after the debridement surgery, and reconstruction of the soft tissue (Calhoun *et al*., 1993). The failure of the previously used antibiotic therapies may be explained by reduction of the efficiency of antibiotics due to decreased regional vascularity because of bone necrosis and biofilm formation in osteomyelitis cases (Tsukayama, 1999).

Fixation materials used in orthopedic operations may act as foci for bacterial colonization. Therefore, removal of the implant is regarded as an important step towards healing (Mader *et al*., 1999). Radiographic symptoms of osteomyelitis are periosteal reaction and new bone deformation, diaphyseal enlargement, osteolysis and radiolucent area, sequestrum formation, effusion in the adjacent joint, and swelling of soft tissue (An *and* Fridman, 1998). Ultrasonographic signs of osteomyelitis include fistulization, periosteal thickening, sinus tract, cortical irregularity, soft tissue abscesses, and fluid collection adjacent to the cortex (Balanika *et al*., 2009). Performing a radiographic assessment prior to the debridement surgery may help localization of the focus of infection (Habson, 1998). In our case, radical surgery was applied due to failed previous antibiotic therapies, presence of sequestrum, radiographic findings positive for osteomyelitis in the amputated bone segments, and recognition of intramedullary pin as a focus of infection. Depending on the isolated pathogen, postoperative antibiotic therapy can be continued for 4-6 weeks (Calhoum *et al*., 1993). Combination of vancomycin and gentamicin was applied for 3 weeks in order to prevent recurrence and possible secondary infections. Since gentamicin is effective against *Staphylococcus aureus* infections and vancomycin is effective against gram-positive, mycobacterium, and particularly gram-negative infections, we preferred to use a combination of those two antibiotics during the postoperative period. No sign of infection was observed during the postoperative period and the operation site healed rapidly.

Radiographic assessment of osteoarthritis is performed based on articular effusion, osteophytosis, intra-articular mineralization, and subchondral sclerosis (Innes *et al*., 2004). Radiographs taken postoperatively at 19 months demonstrated osteophytic growth showing higher density over peri-articular level and minimal intra-articular formation, however, we determined no articular effusion, intra-articular mineralization, and subchondral sclerosis (Fig. 3B, C, D). Postoperative clinical follow-up assessment of the extremity indicated a successful long-term outcome by revealing functionality and absence of signs of deformation and pain.

In conclusion, at the end of the 19-month follow-up period after the radical surgery, no dysfunction or serious long-term complication was observed, and the antibiotherapy was found to be successful in the prevention of infection in our patient treated for post-traumatic osteomyelitis.

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