Case Report: Avascular Bone Necrosis Secondary to Periosteal Damage in a Wedge-Tailed Eagle *Aquila audax*

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Abstract

This paper describes the occurrence of avascular necrosis in the radius of a Wedge-tailed Eagle *(Aquila audax)* secondary to a traumatic injury. The interesting point of this case is that there was no significant evidence of bony damage observed radiographically when the bird was first presented for examination. This case is presented to warn avian veterinary practitioners of the potential for avascular necrosis due to periosteal damage as a sequel to traumatic wing or limb injury in birds.

Introduction

Avian veterinary practitioners are regularly presented with birds that have been injured. Limb injuries, especially to wings, are much more common in wild, free flying or aviary birds than in caged birds (2, 7). On presentation, injured birds need to be assessed for potentially life-threatening disease, injuries that will require later surgical or medical intervention or injuries that will have significant impact on future quality of life. If the injured bird is severely shocked or stressed, the initial examination may be limited or have to be delayed until the bird's condition is stabilized sufficiently to allow a more thorough examination.

Wildlife cases present unique challenges, in that the extent and nature of the injuries must be assessed as to how they will influence the prognosis for future rehabilitation and viable release back to the wild (4, 6). This is particularly the case for birds of prey that rely on unimpaired vision, full coordination and strength and normal flight to capture prey and survive in the wild. Even if the injury is judged to not significantly affect these issues in the long term, the birds may still face rehabilitation periods that can be long in duration and difficult to manage successfully. For this reason, the initial examination of the patient must be thorough and accurate, so that injuries are not missed, misdiagnosed or underestimated for their long-term impact. This will help to ensure that needless time, effort and unnecessary stress and pain are avoided during the following weeks of rehabilitation and recovery.

Consequently, the examination may often require sedation or anaesthesia and thorough physical and opthalmoscopic examination and radiography. However, even despite this, injuries with long-term prognostic implications can still be missed. Two examples of this are coracoid fractures and periosteal damage. A coracoid fracture can often be missed, as it is a difficult area to accurately assess without good quality radiography. If a coracoid fracture is present, the bird's wing carriage

may be normal, but the bird may only be able to fly low to the ground unable to gain sufficient lift to fly higher. Periosteal damage can lead to osteomyelitis or even avascular bone necrosis.

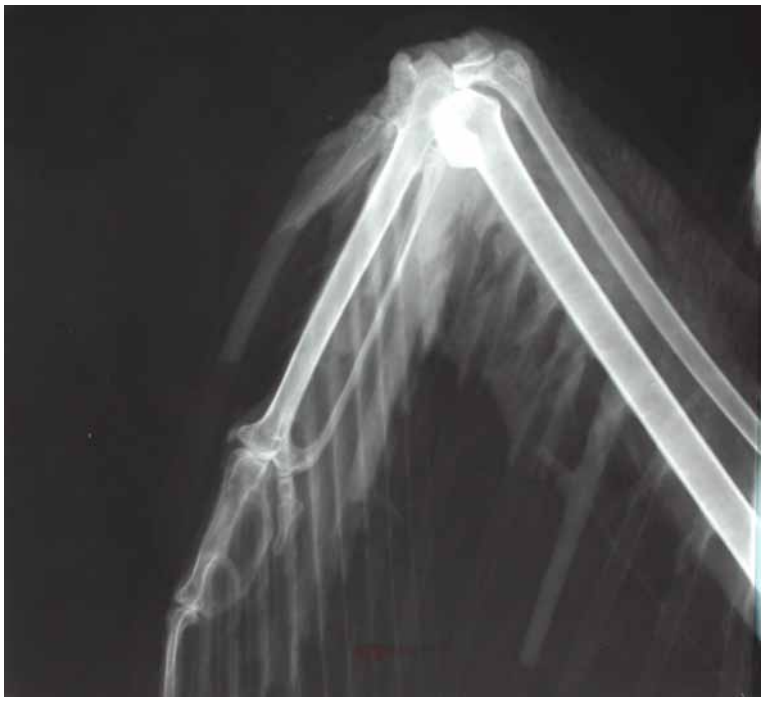
Case Report

A juvenile Wedge-Tailed Eagle was presented to the clinic by a wildlife carer experienced in caring for avian species, especially birds of prey. The eagle had been brought to the wildlife carer after being found unable to fly. The bird was examined carefully by the on-duty veterinarian and found to be quite bright and alert and in good body condition. Opthalmoscopic examination was normal. There were several dry abrasions and superficial lacerations over the phalanges and medial surfaces of both wings. There was a small tear on the oropharyngeal surface of the glottis but the trachea was free of blood and the bird was breathing normally. The main lesion was significant bruising to the underside of the lower radius/ulna, carpus and metacarpal region of the right wing. There also appeared to be some excess mobility in the right carpus.

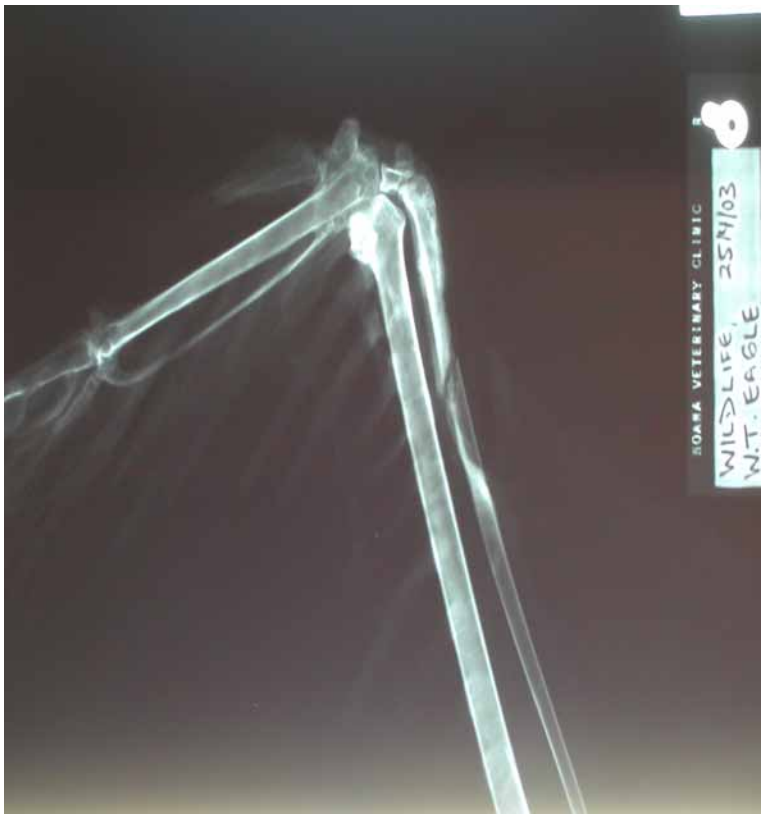
The bird was anaesthetised via mask induction using Isoflurane and radiographs were taken of the right wing. The radiographs revealed a possible separation of the radio-carpal bone from the major metacarpal bone in the right carpus, but failed to show any bony damage or fractures. The bird was treated with injections of meloxicam (Metacam), amoxycillin and multivitamin and, after an uneventful recovery from the anaesthesia, was sent home in the care of the wildlife carer. The bird was dosed daily with oral Metacam and kept in a large room. The bird accepted food from the carer within 24 hours of arriving in this new environment.

The eagle was brought back to the clinic 4 weeks later. The carer had reported that the bird was eating well but was still unable to fly very well (only able to remain in the air for very short distances), was intermittently holding the right wing in a slightly dropped position relative to the left wing and was unable to fully stretch the wing.

The eagle was again anaesthetised with Isoflurane and examined. There was a 50% reduction in the range of extension of the wing. Two outer primary flight feathers were damaged and about to detach from their follicles. There was significant scar tissue or fibrocallous palpable around the distal radius/ulna at the injury site. The skin over the injury site had become necrotic and the site was now covered by dry, necrotic tissue (about 3cms x 1cm in dimension) that extended to the medial surface of the carpus. The carer had noted this lesion but had thought that it was a “scab” and part of the normal healing process. The skin, soft tissue and bone of the wing distal to this lesion were viable and relatively normal in appearance. Radiographs were taken of the pectoral girdle and the lower part of the right wing. The radiographs failed to reveal any fractures of the coracoid, clavicle, scapula or humerus. However, there was a fracture visible in the radius about 4-5 cms from the carpal joint. There appeared to be a 3cm segment of the radius proximal to this fracture line that appeared to be necrotic and sequestered. A significant amount of periosteal reaction and osteomyelitis was also present and the fracture was presumed to be a pathological fracture secondary to the substantial demineralization of the radius. Re-examination of the original radiograph of this site taken 4 weeks previously failed to show any visible evidence of bony damage at this site! (See radiographs below).



Original radiograph (taken on presentation) of distal right wing with no visible pathology in radius. The bruised tissue is visible over the distal radius as an area of slightly increased radiodensity.



Radiograph taken of same section of distal right wing approximately 4 weeks later. Note the lysis of the segment of radius and secondary pathological fracture.

Close-up view of the necrotic segment of right radius. Note the bone lysis and periosteal reaction.

Surgical removal of the necrotic segment of bone generally leads to resolution of these lesions through viable bone callous formation. However, in this case, given the subsequent poor prognosis for normal flight and the need for a long and probably unsuccessful rehabilitation period, the eagle was euthanased with intravenous pentobarbitone sodium.

Discussion

Traumatic injuries are commonly seen in avian species, especially wild birds (2, 7). These injuries, especially if involving the wings, must be fully evaluated with respect to prognosis for flight and future release to the wild. Companion and aviary birds rarely require full mobility following fracture repair, and the post-fracture prognosis for return to function in these birds is generally excellent. By comparison, wild birds (especially birds of prey) must have near perfect wing function in order to survive in the wild (4, 6).

Fractures of the wing that are located near or involving a joint often result in arthritic change or even ankylosis, preventing normal wing function. Open, comminuted fractures are more likely to become infected, resulting in secondary osteomyelitis (4, 6). Injury to the distal wing presents specific challenges. The distal wing has relatively little soft tissue and this soft tissue is quite prone to damage and desiccation (3, 6). Bone in these areas is particularly susceptible to impact-related injuries and possible compromisation of blood supply. One study in Australia found that avascular necrosis was a common complication of distal wing injuries but was not seen in leg injuries (7). The role of the avian periosteum in aiding fracture repair and maintaining bone vascular supply after traumatic injury to some avian bones appears to be very important and sometimes underestimated (1). Also of importance is the fact that the primary and secondary flight feathers (remiges) are attached to the periosteum of the metacarpal bones and the ulna, respectively (6).

The periosteum covers most of the surface of the bones and gains its blood and nerve supply from the surrounding muscles and soft tissue. The periosteum has a regulatory role in longitudinal bone growth, acting as a periosteal envelope and thus restraining epiphyseal growth. During development the periosteum consists of 2 layers, the stratum fibrosum and the stratum cambium.

During embryonic and post-hatch development, the stratum cambium is responsible for some bone formation and is rich in pre-osteoblastic cells. After growth of the bone has ceased, the stratum cambium contains far fewer pre-osteoblasts, but if the bone is injured, these can be reactivated to osteoblasts and help repair the damage by their osteogenic potential (5).

There have been few controlled studies evaluating the healing process of avian wounds and, specifically, avian bone. However, in general, the mechanism of wound and bone healing appears to be similar in birds and mammals, although the process appears to be more rapid in birds. The blood supply to the bones is believed to arise from periosteal (originating from soft tissues and muscles), medullary (originating from nutrient artery), metaphyseal and epiphyseal blood vessels (6).

This case, involving a traumatic injury to the right wing of a Wedge-Tailed Eagle, resulted in the development of avascular necrosis in a segment of the distal radius.
On initial presentation, there was no physical or radiographic evidence of a significant problem with the radius. There was no open wound or suspicion of contamination of deeper tissues. However, there *was* significant bruising at the site of the impact/injury on the underside of the distal radius/ulna, carpal and proximal metacarpal region of the right wing. This bruised tissue eventually lost viability and became hard, dry and necrotic. Avian heterophils lack the proteinase necessary to liquefy necrotic tissue and birds tend to form granulomas that wall off infectious agents and necrotic material. Consequently, osteomyelitis is characterized by caseous, dry and non-draining lesions that are frequently restricted to the site of infection or necrosis and rarely induce secondary systemic infections.

It is likely that the necrosis of this area of skin and soft tissue compromised the blood supply to the periosteum and, subsequently, the bone of the underlying segment of the radius. This led to avascular necrosis of the bone and a secondary pathological fracture. It may also have been possible that the impact of the initial injury caused sub-periosteal haemorrhage leading to separation of the periosteum from the bone and subsequent lack of viability of that section of bone.

The following important points arose from this case:

Blunt trauma to avian bones can result in avascular bone necrosis due to the compromisation of blood supply to the segment of overlying periosteum either, directly from the trauma or, indirectly via the damage to the skin and soft tissue immediately surrounding the periosteum.

Aggressive tissue debridement or manipulation can cause increased damage to already compromised blood supply and soft tissues in cases of distal wing injuries. However, in this case, debridement of the bruised tissue at the time of initial examination or early debridement of the section of skin and soft tissue as soon as possible after becoming necrotic may well have helped to avoid the subsequent necrosis of the underlying bone. This would not be the case if the compromisation of the periosteum was due to sub-periosteal haemorrhage at the time of the initial injury.
Despite initial radiographs showing no bone damage or fractures, frequent follow-up examinations, including radiographs, should be performed. This is particularly the case if significant blunt trauma and bruising to distal wings or legs has occurred. If the bird is not being treated as an in-patient, the first follow-up examination should be within a few days of the initial injury taking place. This is not always easy when dealing with large or easily stressed birds of prey.

Veterinary practitioners, bird owners and wildlife carers should be alert to the possible sequel of avascular bone necrosis due to periosteal damage after blunt trauma, bruising or abrasions to the distal wings (and legs) of birds.

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