Clinical case

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Osteomyelitis and periosteal reaction in a red brocket deer
(Mazama americana)

Osteomielitis y reacción perióstica en un venado soche (Mazama americana)

Osteomelite e reação periosteal em um veado (Mazama americana)

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Summary

Anamnesis and treatment approach: a female red brocket deer *(Mazama americana,* Erxleben 1777) presented a post-traumatic abscess in the left-carpometacarpal joint. The deer was treated with enrofloxacin (5 mg/kg) and ivermectin (0.2 mg/kg) with no response. The animal underwent two surgical procedures to remove purulent material and perform adequate antisepsis as well as several antimicrobial therapies, with satisfactory results in a period of 68 days. **Clinical and laboratory findings:** according to the radiological and laboratory tests the animal developed a metacarpal bone osteomyelitis with periosteal reaction due to a beta-hemolytic *Streptococcus* abscess. **Conclusion:** to our knowledge, this is the first report of medical procedures in this species. The most relevant findings and treatment schedule are discussed.

Key words: *antimicrobial therapy, cervid, post-traumatic abscess.*

Resumen

Anamnesis y aproximación terapéutica: una hembra de venado soche *(Mazama americana),* que presentó un absceso postraumático en la articulación carpo-metacarpiana del miembro anterior izquierdo fue tratada con enrofloxacina (5 mg/kg) e ivermectina (0,2 mg/kg), sin responder al tratamiento. Se sometió a dos procedimientos quirúrgicos con el fin de extraer el material purulento y realizar una antisepsia adecuada, además de varias terapias antibióticas, con resultados satisfactorios en un término de 68 días. **Hallazgos clínicos y de laboratorio:** de acuerdo a los resultados radiológicos y de laboratorio el animal desarrolló osteomielitis con reacción perióstica metacarpiana, debido a un absceso por *Streptococcus* beta-hemolítico.

Conclusión: este es el primer reporte sobre procedimientos médicos en esta especie, se discuten los hallazgos clínicos y el esquema de tratamiento más relevante.

Palabras clave: *absceso postraumático, cérvido, terapia antimicrobiana.*

Resumo

História e tratamento: uma fêmea de veado (*Mazama americana*) apresentou um abscesso pós-traumático na articulação do carpo-metacarpo do membro esquerdo. Foi tratada com enrofloxacino (5 mg/kg) e ivermectina (0,2 mg/kg), sem responder ao tratamento. Logo foi submetida a dois procedimentos cirúrgicos para remover o pus e fazer limpeza com antisséptico apropriado, além de várias terapias antibióticas, com resultados satisfatórios em um período de 68 dias. **Resultados clínicos e laboratoriais**: de acordo com os resultados dos exames radiológicos e de laboratório, o animal desenvolveu osteomielite no metacarpo com reação periosteal devido a um abscesso por *Streptococcus* beta-hemolítico. **Conclusão:** este é o primeiro relatório sobre procedimentos médicos nesta espécie, discutimos os achados clínicos e o sistema de tratamento adequado.

Palavras chave: *abscesso pós-traumático, cervídeo, terapia antimicrobiana.*

Introduction

The red brocket deer *(Mazama americana)* is native to South America and is included in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. This species is the largest of the genus *Mazama*, reaching 30 to 40 kg body weight and 65 cm height. The species inhabits dense forests and riverbanks covered with vegetation (Mayor *et al.*, 2011; Abril *et al.*, 2010). The IUCN classifies this species as "data deficient" (IUCN, 2008) and the conservation status of its wild populations is unknown.

The most common infectious diseases on cervids are usually caused by *Yersinia pseudotuberculosis, Corynebacterium (Actinomyces) pyogenes, Escherichia coli, Pasteurella multocida, Streptococcus* spp*., Staphylococcus* spp., *Fusobacterium necrophorum,* and *Pseudomonas* spp. (Barbanti *et al.,* 2001).

According to reports and studies on wild cervids around the world, mandibular osteomyelitis is a common *post-mortem* finding (Konjevic *et al.,* 2011; Flueck and Smith-Flueck, 2008). Konjevic *et al.* (2011) reported a Slovenian deer *(Capreolus capreolus)* with chronic pyogranulomatous mandibular osteomyelitis. Osteomyelitis has been observed only in the jaw of wild elk and reindeer in North America (Hoefs and Bunch, 2001). Pathogenicity and mortality caused by this disease is unknown in wild cervids. Some authors suggest that this infectious process could be subclinical. According to a study of Patagonian huemules *(Hippocamelus bisulcus)* the most common bone diseases are secondary alveolar chronic osteomyelitis and osteoarthritis (Flueck and Smith-Flueck, 2008).

Although cervid pathologies are well known, currently there are no protocols for their treatment. For this reason, it is necessary to extrapolate treatments described for domestic mammals such as horses. The previously established treatment principles for septic arthritis and osteomyelitis in horses include systemic broad-spectrum antimicrobial drugs that reach effective concentrations in bone (Hardy, 2006).

However, medical procedures for captive cervids are limited because of their nervous behavior and incidence of post-capture myopathy syndrome, a problem that is easily developed and potentially fatal. This situation makes the procedures recommended in the literature impractical.

Patient examination

Anamnesis

A female red brocket deer was found with superficial wounds, caused by intra-specific aggression. The deer presented 1/4 lameness in the left forelimb (Flo *et al.,* 2002), without superficial injuries. The treatment assigned was oral ivermectin as a preventive therapy against myasis, and enrofloxacin for 5 days (Table 1). An abscess compromising the fifth phalanx of the left forelimb was found in the carpometacarpal joint (Figure 1). Enrofloxacin and meloxicam therapy was initiated (Table 1). As the animal had a 2/4 lameness (Flo *et al.,* 2002) on day 13, a chemical restrain with previous fasting was initiated using Zoletil 50® (Tiletamin/Zolacepam) and Rompun 2%® (Xylazine hydrochloride) intramuscular (Table 1). During removal of the abscess the animal was anesthetized and given oxygen (6 L/m).

Table 1. Medications provided throughout the treatment.

Medication	Trade names and presentations	Relative doses
Ivermectin 0.6 gr	Ivermectina Genfar® oral solution	0.2 mg/kg
Enrofloxacin 10%	Floxaviar®, oral solution	5 mg/kg
Enrofloxacin 150 mg	Baytril® tablets	5 mg/kg
Meloxicam 3 mg	Meloxicam® tablets	0.2 mg/kg
Tiletamine-Zolazepam 50 mg	Zoletil®	4 mg/kg
Xylazine 2%	Rompun®	1 mg/kg
Zinc oxide, Allantoin, Lidocaine, Neomycin sulfate and Kalaya oil	Pezosan-N®	Topical
Meloxicam 7.5 mg	Meloxicam®, tablets	0.2 mg/kg
	Rumicell®	3 gr/animal
Vitamin E 400 UI	Aquasol-E®, soft capsules	7 IU
Fluconazole 200 mg	Fluconazol®, capsules	
Enrofloxacin 10%	Enrovet®, injection solution	10 mg/kg
Penicillin G; benzathine-procaine-sodium	Ganapen LA 7.5®	22,000 IU/kg

Clinical findings

The animal was in adequate body condition (3/5), and presented recent rostral abrasions and a post-traumatic abscess (Figure 1; Table 2).

Figure 1. Post-traumatic abscess of the left forelimb before surgical procedure (day 13).

Table 2. Physiological parameters and general physical examination results on day 13.

Parameter	Units	Values
Weight	Kilograms	25 (approx.)
Temperature	Degrees Celsius	39
Respiratory rate	Breaths/min	75
Heart rate	Beats/min	80
Lymph nodes		Apparently normal
Body condition	3	Good

Therapeutic approach

A surgical procedure was performed to extract caseous and necrotic material of the fifth phalanx. A deep digital flexor tendon resection was observed and could not be fixed. The healthy phalanx was fixed to fibrous connective tissue with a tension suture. The wound was left open, with a wick impregnated with healing ointment and an elastic bandage. Medications and doses used during surgery are described in table 3. The animal was treated with antimicrobial drugs for 7 days and continued with analgesic therapy. A probiotic and antioxidant therapy with vitamin E was started on day 16. On day 17 the animal had diarrhea. Consequently, oral antimicrobial therapy was suspended.

Table 3. Medications used on day 13, at time of surgical procedure.

Medication	Relative dose (mg/kg)	Dose administered (ml)
Ganapen 7.5 LA® (penicillin G; benzathine-procaine-sodium)	22,000 UI/kg	1.4 IM*
Meloxic 0.5%® (meloxicam)	0.2	1 IM*
Dexablas 0.4%® (dexamethasone)	0.1	0.6 IM*
Biosolamine® (energizing-antioxidant)		3 IM*
Ringer's Lactate® (crystalloid solution)	10 ml/kg/hr	250 ml, 1 drop/sec.

*IM; Intramuscular.

Monitoring

Analgesic and antioxidant therapy was restarted. Prophylactic antifungal therapy was also administered (Table 1). Lameness increased to 4/4 (Flo *et al.*, 2002) on day 30, with a very swollen forelimb and a fistula. Antimicrobial therapy was restarted. A second surgical procedure was scheduled.

Second surgical procedure

Surgery was performed on day 33 day using the same anesthetic protocol (Table 1). Blood samples were taken from the saphenous vein during surgery for Complete Blood Count (CBC, Table 4) and blood chemistry (Table 5). Additionally, a deep swab was taken for culture as well as two radiographs: 1) Latero-lateral (LL) view of the carpometacarpal joint; 2) Antero-posterior (AP) view comparing both forelimbs.

Table 4. CBC result. Taken on day 33, during the second surgical procedure.

Test	Result	Units	Reference values*
Hematocrit	40	%	30.7-45.9
Hemoglobin	13	g/dl	10.7-16.5
Erythrocytes	9.76	*10>6/mm<3	6.8-13.9
Platelets	106	*10>3/mm<3	312-642
Total proteins	80	g/lt	53-95
Fibrinogen	13.5	g/lt	4-5.4
Leukocytes	4.95	*10>3/mm<3	2.4-7.1
Segmented neutrophils	3.22	*10>3/mm<3	0.78-3.44
Lymphocytes	1.49	*10>3/mm<3	0.59-1.79
Monocytes	0	*10>3/mm<3	0.03-0.17

*Taken from International Species Information System (ISIS).

Table 5. Serum biochemical analysis taken on day 33 during the second surgical procedure.

Test	Result	Units	Reference values**
Globulin	72.1	g/lt	31-53
BUN*	19.81	mmol/lt	10-20
Creatinine	1.43	mmol/lt	1-1.7
AST*	702	U/L	56-178
GGT*	56.4	U/L	15-167
Total proteins	93.5	U/L	64-84
Albumin	21.4	U/L	23-39
Calcium	11.08	mg/dl	7.8-10.6
Phosphorus	5.8	mg/dl	6.2-11

*BUN: Blood Urea Nitrogen; AST: Aspartate Amino-Transferase; GGT: Gamma Glutamyl-Transferase. **Taken from International Species Information System, ISIS.

At the surgical procedure, the wound and the surrounding tissue were swollen with exposure and avulsion of the deep digital flexor tendon. A deep wash with Harris solution was performed. The necrotic and infected tissues were removed. A tension suture was made. Physiological parameters were maintained as normal and oxygen saturation ranged between 77% and 94%. The animal was left in an outdoor enclosure with plenty of hay for recovery.

The CBC results showed marked thrombocytopenia associated with platelet aggregation. The biochemistry serum result showed aspartate aminotransferase (AST) increased 3.9 times due to the muscle trauma. Hyperproteinemia, hyperglobulinemia, and hypoalbuminemia were correlated with a chronic inflammatory process. This was also correlated with fibrinogen increase. Additionally, hypercalcemia caused by septic osteomyelitis was found. Hypophosphatemia is usually associated with hypercalcemia (Sodikoff, 1996).

Monitoring

The radiographic findings demonstrated osteomyelitis in the carpometacarpal joint, with metacarpal periosteal reaction (Figures 2 and 3). Figure 4 shows the wound on day 34.

Figure 2. Left forelimb LL radiography. Note the periosteal reaction in the metacarpal (fine arrow) and the inflammation of soft tissue (large arrow).

Figure 3. AP forelegs comparative radiography. Periosteal reaction is appreciated and partial loss of the 5th phalanx affected limb (large arrows). Note metacarpal periosteal reaction in the injured limb compared with the healthy (fine arrows).

Treatment was altered after receiving bacterial culture and sensivity testing results (Table 6). Enrofloxacin was exchanged for Ganapen LA 7.5®, a long-acting penicillin (Table 1). The animal had a guarded prognosis.

Table 6. Bacterial culture and sensivity result at day 33.

Result: Beta-hemolytic *Streptococcus* from the *B. agalactiae* group was isolated	
Note	All streptococci are sensitive to penicillins

Antimicrobial systemic therapy was suspended at day 53 because the animal showed clinical improvement. Analgesic and antioxidant therapy continued. Figure 5 shows the lesion and the affected limb at day 84, at full recovery.

Figure 4. Lesion on day 34.

Figure 5. Affected limb at day 84. Red arrows indicate the area where the injury was located.

Discussion

Beta-hemolytic *Streptococcus* was isolated at the culture testing. This bacterium is included among commonly infectious etiologic agents in cervids. This is an important finding because osteomyelitis has been reported in wild cervids around the world (Konjevic *et al.*, 2011; Flueck and Smith-Flueck, 2008), *Actinomyces pyogenes* being the most common etiologic agent for abscesses (Wobeser, 2001; Turnquist and Fales, 1998). Pathogens such as *Actinobacillus* sp., *Escherichia coli*, *Klebsiella* spp., *Pseudomonas* spp., *Salmonella* spp. and *Streptococcus* spp. have been described in horses with septic arthritis and osteomyelitis (Hardy, 2006).

Radiographs are essential diagnostic tools for traumas unresponsive to therapy. Therefore, diagnosis should not be limited to a single radiograph. In the case of osteomyelitis or arthritis-affected horses, radiographs should be taken on a weekly basis until clinical signs of deterioration or resolution are present (Hardy, 2006).

In the case presented here, it is important to highlight that therapy was successful because of the docile temperament of this particular animal, which allowed a favorable medical management. It is also important to ensure appropriate antimicrobial therapy from the beginning. Additionally, the presence of osteomyelitis suggests antimicrobial drug combinations should be used to reach effective concentrations in bones and achieve a synergistic effect (Hardy, 2006). An aggressive therapy with long-action penicillin was implemented after beta-hemolytic *Streptococcus* was isolated. Rifamycin was administered as a local antimicrobial drug. Rifamycin combined with other drugs is effective in treating osteomyelitis and septic arthritis, however is not recommended to be administered by itself because it can rapidly generate bacterial resistance (Hardy, 2006).

Conclusion

Although the patient was a cervid, this case had a positive outcome because its docility and human acceptance facilitated handling and medical treatment. It is the important to emphasize animal conditioning programs for medical procedures in captive wildlife in order to facilitate successful medical therapy.

Literature reports about interventions and medical procedures with these animals in captivity are scarce. It is recommended to refer to data from similar species, which allow extrapolating therapies and medical handling.

Acknowledgements

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